COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XVII APRIL, 1912 No. 4

COMPRESSOR CARRIES ITSELF.

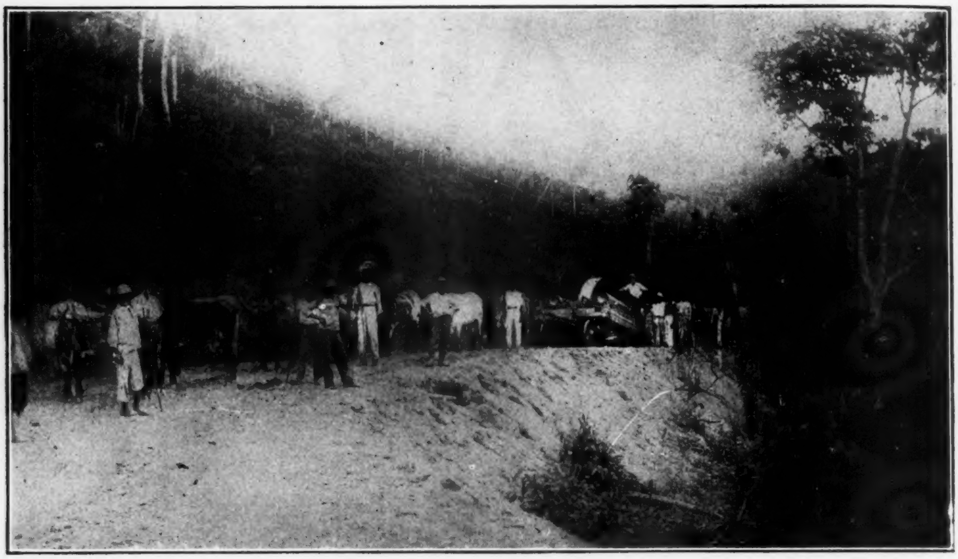
NOT PATENTED

The photos reproduced upon this and the following page came to the editor of Compressed Air Magazine from Mr. D. H. Campbell, Rio Janeiro, Brazil. They tell clearly and completely the story of a unique scheme of machinery transportation. It is seldom that a patented device—which this of course is not—embodies such an example of successfully applied ingenuity.

In his letter accompanying the photos Mr. Campbell says: "I enclose a couple of views of an Imperial, Type X., air compressor in transit which may be of interest to your readers."

It will be noted further along that not only one but several compressors have been transported as here shown.

Continuing, the letter says: "To meet the conditions of these roads in the rainy season,



ON A ROAD IN BRAZIL.

the deep mud, the sharp turns on heavy grades, I resorted to the expedient shown. The machine is stripped of everything so that there is only the bedplate with crank shaft and wheel, and the weight is practically all on the wheel, the face of which is so wide that it does not sink much in the mud and the short wheel base make it easy to get around the sharp turns.

"Going down hill I drove a wedge between the face of the wheel and the bedplate to act as a brake. It was necessary to guide with men and not rely on the oxen.

"I find that I can move one of these machines in this way in the rainy season at the rate of 8 kilometres (5 miles) per day on 12 per cent. maximum grades. The roads are new with long 'supported' grades of uniform rates; but 18 head of oxen are sufficient for a 12 per cent. grade.

"The compressors have been delivered in this manner without injury of any sort."

The air pressure produced by an explosion often renders a miner unconscious, so that the after-damp catches and kills even when the victim was neither burned nor near the initial explosion.

AVIATION SPEED RECORDS

On January 19th Vedrines, on a 100-horse-power Gnome-engined Deperdussin monoplane broke Nieuport's records for all distances from 5 to 40 kilometers, his 100-kilometer (62.1 mile) record, and C. T. Weymann's 150-kilometer (93-mile) record made in a 100-horse-power Nieuport monoplane when he won the Bennett Cup race on July 1st, 1911, in England. Vedrine's records for 5, 10, 20, 30 and 40 kilometers in minutes and seconds, are, respectively, 2:06 2/5; 4:13 2/5; 8:26 3/5; 12:40 4/5; 16:53. One hundred kilometers were covered in 41:56 4/5 as against 46:27 2/5 by Nieuport; and 150 in 62:43 4/5 as against 71;36 1/5 by Weyman. In one hour Vedrines flew 142.43 kilometers (88.50 miles), showing that his speed was 8 1/3 miles per hour faster than that attained by Nieuport. The fastest speed made in any 5-kilometer circuit was 145.177 kilometers, or 90.2 miles an hour. This was 7½ miles per hour faster than Nieuport's fastest lap. On January 24th Maurice Tabuteau, with a Borel monoplane, made new records for 200, 250, and 300 kilometers (124.28, 155.35, and 186.41 miles) of 1:54:21; 2:22:57; and 2:51:00, respectively. His average speed for the first mentioned distance was 64.87 miles per hour.

AMERICAN AND FOREIGN WAGES AND EFFICIENCY

BY W. L. SAUNDERS.

[The Editor of Compressed Air Magazine recently completed a five-months' journey around the world. A meeting of the American Institute of Mining Engineers having been held in San Francisco, a number of the members took the opportunity to visit Japan, while Mr. Saunders with some others of the party entered Korea and then crossed Siberia to Europe, visiting a number of countries, including Russia, Germany, Austria, France and England. The views here presented have special pertinence as bearing upon pending National and current popular discussion. R.]

Any one who travels for the first time over new fields with his mind free and his interest centered upon business conditions in manufacturing is a very poor judge of things, but a man who goes over beaten tracks from time to time with the same ends in view and with past experiences to steer him should be competent to draw comparisons and to reach conclusions with some degree of accuracy and value.

The manufacturing world is not large and that part of it which makes machinery is a comparatively limited field. The land of this world is more largely given up to agriculture than to any other purpose. Farming does not concentrate population or build up large cities. The products of the soil are greater in value than anything else that is produced, not only because the people are fed, but through the income derived from Nature's products. Railroads are mostly made possible and profitable through agricultural conditions. The same may be said of shipping and of a great many other things which add to the wealth and prosperity of the people, but next in importance to every country and to all people is the development of its manufactures.

MANUFACTURING CENTRES NOT BUILT ON CHEAP LABOR.

In looking for causes which have produced great manufacturing centers two things stand out prominently, namely, favorable natural conditions and markets. A plentiful supply of crude labor is not a condition of such great importance as is popularly supposed because where there is an abundance of labor and where it is cheap the best and most productive manufacturing does not exist. Take, for instance, India, China and Japan, countries where there is a plentiful supply of cheap and intelligent labor, which might through proper training be made to produce iron and steel products, for instance, equal in efficiency to the English, American and German products, yet no such results have been derived, and the answer usually given, that it is because of lack of capital, is not a true answer, because if it were the fact that to cut labor in two would save money and add to profits in any line capital would flow in that direction. Capital for this purpose usually concentrates itself as near as possible to the markets where each particular product is consumed, and the very fact that it does so concentrate itself means so great an enlargement of these markets through increased population and prosperity that new fields are not sought.

EFFICIENT LABOR THE BASIS OF SUCCESS.

In mechanical things, at least, skilled labor is really the essential basis of success in manufacture. The first and largest item on the cost sheet is the item of labor and the maker who thinks that because this is true he should turn to a country where labor is cheap will surely court disaster. Efficiency of labor and the best tools are the important things which maintain supremacy in any line. Efficient labor comes through the work of a life time and cannot be made in a day. It is furthermore plain to those with the world's experience before them that just in proportion as labor becomes more efficient and as tools become more productive does the price of labor go up, and this is the chief thought which has impressed me during a recent trip around the world.

England was up to recent years in advance of any other country in mechanical manufacturing. America with higher labor and Germany with lower labor have both made considerable headway against her. In the case of America the headway has not been made because labor was higher but in spite of it and because of other conditions which have compensated for higher labor. In Germany the progress has not been because of lower labor, but through the spirit of her people, coupled with good engineering and business energy and push, equal if not greater to that of America.

BRITISH AND GERMAN LABOR COSTS ADVANCING.

It is worthy of notice that while the price of mechanical labor in America had stood comparatively still, or has had but a moderate advance during say the last twenty years, the price of the same labor in Germany and England has increased at least one hundred per cent. Mechanical labor in Germany, which is today one-half that of the United States, was but one-quarter twenty years ago.

It is usual to attribute this to the growing strength of labor unions, and it must not be forgotten that labor unions have added materially to the strength of labor in the countries mentioned, but labor unions are only strong where they are able to exercise at least some control over the situation, either through a limited supply, through legislation or otherwise. In a country like Japan, for instance, labor is so plentiful, both male and female, that unions are made hopeless in their efforts to control, and a manufacturer there who might be disposed to rebel against labor union requirements would draw from this large field and cultivate new men rather than submit.

JAPAN'S LABOR LOW PRICED AND INEFFICIENT.

In such large plants as the Imperial Steel Works of Japan mechanical labor costs about 30 cents a day for men and 15 cents for women. Women in Japan in many cases replace the men, except in places where heavy work is required. In a copper smelter in Japan I saw a young girl handling the levers by which the transportation cars were shifted. For this she received 10 cents per day. The man who lifted the metal from the car was receiving 20 cents per day, yet it is a fact that notwithstanding these astonishingly favorable conditions, so far as labor is concerned, the Imperial Steel Works, for instance, do not pay, though the product is equal to that produced anywhere else. One naturally looks for a reason for this, because the Steel Works are located at tide water and transportation in ships is not expensive. The conclusion is inevitable, that this labor per unit is of very low efficiency and that it cannot be made efficient except through long years of experience and with markets sufficient to warrant a large product of each one thing. Here we come to the revelation of the true reason of American progress in these lines. Our markets are so close and so fruitful that the single high-priced man working on a single thing each day gets the labor unit of cost down and this fact has enabled American manufacturers to compete in foreign fields.

We must not, however, lose sight of the gradual and pronounced increase in the cost of labor in foreign manufacturing countries. Should Japan, for instance, ever reach prominence in her steel manufacturing we may rest assured that at that time her labor prices will be increased several hundred per cent.

GERMAN COMPETITION TO BE FIXED.

Japan is not a manufacturing country and is not likely to be within the life time of those who may be interested in this subject, so the practical question to consider is which country is that which threatens English and American supremacy, and in considering this let us look into the reasons. The answer is plainly Germany. The Germans are natural mechanics. They are intelligent, resourceful and they work like beavers. There intelligence is initiative and inventive. Inventive to the extent of not only originating things, but they have the greater faculty from the commercial standpoint of taking advantage of things which may have originated elsewhere, improving them, perfecting them and making the best possible use of them.

There is nothing altruistic or sentimental about the German manufacturer. He goes for the thing that is best and he studies the best and cheapest way to produce it. The German mechanical engineer is equal if not superior to any one working in the same field. He is a student of detail. He takes nothing for granted, he finds out what has been done elsewhere, how far it goes, and he studiously and on practical lines seeks ways and means by which to go one step further. Take the steam engine, for instance, which we are accustomed to look upon as an American product. It was invented in England, but the invention of anything mechanical is only the first step toward success. Watt, Newcomen, Corliss and others, carried the engine through successive steps of higher efficiency until we in America practically laid down on the Corliss, thinking that we had reached the limit of efficiency for the reciprocating type of machine. The Germans did not stop, and it is a fact which can hardly be disputed, that today the reciprocating en-

gine has reached a higher stage in Germany than anywhere else in the world. Through the use of poppet valves, steam heating, and greater attention to details, the Germans are offering reciprocating engines at an efficiency lower than American or English manufacturers. I do not refer to the Diesel and other special types of reciprocating engines, but to the regular steam engine, which notwithstanding the Turbine and other means of producing horse power from steam, still holds its place in the largest field and with the highest efficiency under general conditions of service.

GERMAN WAGES AND EFFICIENCY RISING TOGETHER.

The steam engine is only used to illustrate the point, which is that German growth, which might almost be said to be supremacy in certain mechanical fields, is not due alone to German cheap labor. At the present time German labor is cheaper, but it is going up faster than the labor of England or America, and its unit of efficiency grows in the same proportion as the price increases. German manufacturers are located under favorable conditions for material and markets; they have plenty of iron, coal and limestone at their doors and large shipping, and markets extending throughout Europe, Asia and South America. The product is on a large scale in those lines where experience has been extensive and they have the brains, the push and the money to reach other and even competitive countries.

PENDING TARIFF LEGISLATION.

This brings us to the all important question of tariff. The American tariff has heretofore been prohibitive. Shall we now take down the bars and admit German products which will surely come? Are American manufacturers in mechanical lines ready to meet this competition on practically equal terms? Have they had time enough to prepare for it and is it their fault if they are not ready?

In the first place, every fair man will acknowledge that if we are to remove mountains we should begin on grains of sand and that whether we are protectionists or free traders a condition exists and has existed for a large period of years which has materially aided the building up of American industries. That condition is one of high protection. All plans have been made under it. The wheels of our works have been tuned to it and the avenues are paved for it, so that whether we are ready or not no concern should be put to the test of a sudden and radical change in well established conditions of business. Time should be given to prepare for the assaults of a business enemy and justice in this line can only be done by taking down the bars one at a time, with sufficient time in between to safeguard the property of the people and to maintain the stability of our industrial conditions. True protection is that which protects those industries only which require it, and without providing the opportunity for monopoly abuses.

THE OZONE FAD

Faith in the subtle and far-reaching effects and the health-giving virtues which have at one time or another been attributed to ozone has somehow been instilled into the popular mind. Seaside and mountain resorts alike have benefited by the reputation of "ozone in the air" in the neighborhoods involved. The excusable longing of an ever-ailing population for a stimulating atmosphere and for an ideal antiseptic has led many to look hopefully toward that substance which appears to represent the acme of the valuable properties of oxygen. The honest manufacturer and the medicine faker have both been alert to avail themselves of the opportunity for public service, so that "ozonizers" and "ozonized" products are displayed in abundance.

The ozone question presents its facts as well as its fiction. Ozone undoubtedly has antiseptic power; but for such effects a dangerous concentration appears to be necessary. Lately it has become possible to prepare pure ozone and to investigate its physiologic properties. Prof. Leonard Hill and Dr. Martin Flack of London find that "a concentration as little as one per million is irritating to the respiratory tract. Exposure for two hours to a concentration of fifteen to twenty per million is not without risk to life."

The concentration of ozone necessary to kill bacilli would also kill tissues in which they occur. There is no harm in breathing weak concentrations of ozone. Ozone in somewhat higher concentrations (one per million) may have some value, but proof of its value may well be demanded, especially so long as there are other and better curative agencies—*The Journal of the American Medical Association.*

CEMENT GROUT AND COMPRESSED AIR IN SHAFT SINKING

BY R. C. JOHNSON.

Without doubt the most important step that has been taken in connection with sinking shafts in this country during recent years, is the introduction of the process for cementing water-bearing seams encountered in the sinking. Although the process has been used in a rather similar form in Germany, no reports show that its practice has extended to the grouting of comparatively small water-bearing fissures, with the idea of making practically dry shafts. In general it has been used there only when huge flows have been encountered and exceptionally great expense for pumping has been forced on the operator.

The process as actually used here, is one of forcing Portland cement grout into holes drilled in the bottom of the shaft, the cement and water being mixed in an air-stirred grout tank which is connected directly to the compressed-air supply on one side and to the hole to be grouted on the other. In view of the wonderful possibilities that the process offers for saving money, a brief description of the method as it would be used in the sinking of mine shafts should be of interest to those who have shafts to sink or to those who for years have been pumping water from the bottoms of wet shafts. To the latter, the advantages of the process will probably appeal most strongly.

DESCRIPTION OF METHODS.

Sinking is started in the usual manner. As soon as the drills "cut" water, preparations are made for grouting. The air line which is used for drilling is run close to the bottom of the shaft for connection to the grout tank. The drilling is continued until the longest length of steel used is run into the holes. Then the drills are taken out of the shaft and a small specially shaped pipe nipple, wrapped about its enlarged portion with flannel or burlap, is driven tightly into one of the holes.

To this nipple is connected a piece of high pressure hose that leads to the grout tank on the floor of the shaft. This tank is made of boiler plate, has about 4 cu. ft. capacity and is similar in shape to an upright air receiver on legs. As shown in Fig. 1, there are pipe connections for air at the top and bottom and a connection for the discharge of the grout.

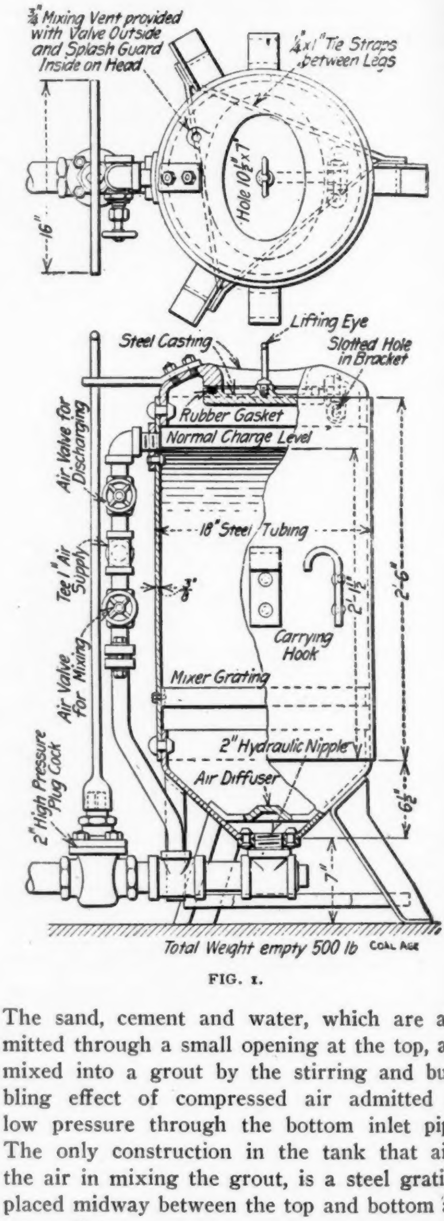


FIG. 1.

The sand, cement and water, which are admitted through a small opening at the top, are mixed into a grout by the stirring and bubbling effect of compressed air admitted at low pressure through the bottom inlet pipe. The only construction in the tank that aids the air in mixing the grout, is a steel grating placed midway between the top and bottom air connections.

At the bottom of the tank and opposite to the lower air connection is the pipe way for leading the grout to the drilled holes. Just before the grouting is started, the drill hole is cleaned by pumping, if it is merely a running hole; if the hole is a spouter it will practically clean itself.

FORCING IN THE GROUT.

The pipes are then connected to the nipple in the hole, the batch is put into the tank and air at low pressure is admitted through the bottom connection, for stirring purposes. Next, the tank door and all plug cocks are closed except one which admits air for running up the pressure in the tank to the desired mark. The plug cocks in the discharge line are then opened and the grout is forced into the hole and into all the crevices leading to the hole. The holes are grouted to refusal; that is, until the gage shows by the rise of pressure that all crevices connecting with the hole are filled. The plug cock nearest the tank is then opened and the charge wasted. The other plug cock, immediately above the hole, is next closed, the grout hose disconnected from above the valve and the tank and pipes cleaned by blowing out. The apparatus is then connected to another hole.

If the grout from the first hole is seen bubbling up in other holes, they are immediately plugged. Such bubbling shows, of courese, that fissures are connecting the several holes. The one grouting connection will in this case serve for all the holes in which the grout is seen. If the grout is seen to rise through crevices in the floor of the shaft, a different method of procedure is required. It is necessary to place over the floor of the shaft a reinforced concrete mattresses which is allowed to set for a couple of days. Holes are then drilled through this mattress, just as if it were a shaft bottom, and the grouting process is continued as before.

At first, the drill holes are placed over the shaft bottom just as they are spaced for shooting, and the grout tank is connected to every hole that shows water. The grout is allowed to set for about 8 hours and after this, test holes, deeper than the regular round, are placed along the rib. If these show water, they are grouted and additional test holes are drilled until no water rises from the rock. The shaft is then again drilled for shooting, the number of side holes being increased so as to cut the rib as clean as possible and keep the grouted seams solid. In the regular process of sinking the shaft, the sump is then fired and mucked. The grout will appear in the crevices it has filled, like a white fine-grained sand stone. In one instance, a section of a gneiss rib, so treated, appeared as a prominently white-streaked dark marble. The benches are then fired and sinking resumed in the usual manner until more water is "cut," when the process is repeated.

PRESSURES REQUIRED FOR GROUTING.

The pressure required to grout a hole is dependent on the pressure of the water coming from the hole, because the grout must take the place of the water. Theoretically the application of this process is limited only by the pressure that the air compressor can develop and the air connections can withstand. The height that the water reaches as it spouts from the drilled hole is an accurate indicator of the least air pressure that will be required but the pressure actually used will be often much greater than indicated by this head, in order that the most minute crevices may be plugged.

However, when using high pressure every precaution must be taken against blowing out the nipples and breaking the connections. In one case, described later, it was actually necessary to drill the rock and insert wedge bolts to chain down the pipe connections to the holes. The water and sand spouted from these holes with such force that a 2-in. plank, placed over the hole to deflect the water, was in one case completely bored through in about two minutes. While drilling one of these holes, a 10-ft. steel dropped down the bore when it struck a stratum of sandy disintegrated gneiss that was later found to be producing the water. In a few minutes the steel was seen to shoot out of the hole and some distance up the shaft with a stream of sand and water behind it.

RECENT GROUTING OPERATIONS.

In sinking the No. 4 shaft of the city tunnel for the Catskill Aqueduct in New York, a stream of water was encountered at a depth of 149 ft. As soon as the drills struck the water the contractor decided to attempt to cut off the flow by plugging the crevices with cement grout. Anyone familiar with shaft sinking knows of the many difficulties of pumping, and in round shafts such as are the large majority on this Aqueduct, the troubles are more than doubled because of the general practice of drilling the entire round on one shift. The handling of a pump at the bottom of a round shaft for only 30 gal. of water per min. means

a loss of at least 5 ft. of sinking per week. It was of advantage then, both to the city which paid for the pumping and to the contractor as an aid to his speed that the water bearing fissures should be grouted if possible. Accordingly a grout machine of the Caniff patent type was procured and taken down the shaft for connection to the holes showing water. Only two days were lost in completely sealing off the flow and the sinking was resumed.

However, on Oct. 28, at a depth of 183 ft., the drills "cut" a stream of such high pressure that while there was no loss of time in deciding what methods to pursue, there was, and still is, considerable speculation as to its cause. A gage placed on one of the drill holes registered 65 lb. and it required but a moment to figure that the water was coming from near the rock surface. The shaft is situated within 100 ft. of the Jerome Park reservoir and within a few hundred feet of the Croton Aqueduct. Shooting into the water under such pressure seemed suicide and as later developed, the shaft would probably have been "drowned out" had it been attempted.

It was decided to provide a high pressure grout machine with high pressure fittings. As previously noted it is essential that the grout be forced into even the finest crevices, and when it is known that over 300 lb. pressure was used on some of the holes—335 lb. on one of them—the effectiveness of the work can be appreciated. Nevertheless test hole after test hole was drilled and still the water persisted in appearing. Finally a complete ring of holes was drilled around the periphery of the shaft, the holes being kept close together. These were grouted and the cut and side holes fired. The water pressure had decreased considerably but a new condition appeared.

A CONCRETE MATTRESS USED.

The bottom of the sump was soft and sandy and soon proved to be badly disintegrated gneiss, an unusual occurrence, surrounded as it was by the hardest kind of material. Attempts to grout off the water in this sandy structure failed at first because the grout would bubble to the surface and allow but little pressure to be put into the holes. It was finally found necessary to cover the whole shaft bottom with a reinforced concrete mattress as shown in Fig. 2. The concrete was placed on corrugated iron to allow drainage to

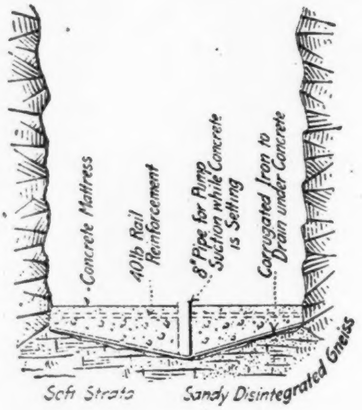


FIG. 2.

an 8 in. pipe that was stood upright in the center of the shaft to carry the pump suction while the concrete was setting. Holes were then drilled through the mattress and down into the rock and attempts made to grout.

The flow was decreased considerably but not entirely. The reason for this became clear when the concrete was removed and the rock shot up. Pieces of the grout, shaped precisely like a diamond drill core, were found in the muck with clumps of cemented sand clinging to them. Clean, or even fairly clean, crevices were grouted perfectly, but strata of sand were only matted in spots and it was from these strata that the remaining water was coming. Sinking was then continued for about 20 ft. and the regular concrete lining of the shaft was started.

The shaft was enlarged through the soft sandy strata so as to permit ample drainage channels behind a heavier-than-usual reinforced concrete lining. Grout pipes were run from the inside face of the lining back to these drainage channels. These pipes carried the water through the lining into the shaft and, after the concrete had set for a week or so, they were closed with ordinary plugs, thus completely shutting off the entire flow. Later, these plugs were removed and grout was forced in behind the lining to fill the drainage channels.

ADVANTAGES TO THE MINE OPERATOR IN OBTAINING DRY SHAFTS.

The fact that the problem of dealing with the water encountered in sinking a shaft has met with a new and effectual solution, marks a big step forward, but by all odds the great-

est advantage of the grouting process is the saving of money that the mine owner would otherwise have to spend year after year in pumping the water of a wet shaft. The cost of pumping 200 gal. of water per minute from the bottom of a mine shaft 500 ft. deep is easily figured. This is probably an average quantity for a shaft of that depth and will require about 25 water horsepower. Taking as a basis a direct acting pump using 90 lbs. of steam per horsepower hour it is readily figured that 75 boiler horsepower are required. A horsepower will cost the mine operator about $20.00 per year and $1500.00 per year will be the total expense for pumping the shaft water.

Grouting with cement and sand as the shaft is being sunk will save this expense and, under ordinary conditions, crevices that will produce a flow of 200 gal. per minute, can be grouted solid for much less than a year's cost for pumping. With successful grouting, no water rings will be required and so the actual increase of first cost to the mine operator will be small. The idea is new in this country and the method as it has been described here is entirely new to shaft sinking practice. It has proved a success in every instance that it has been tried of late, and engineers who have studied the operation pronounce the shaft water problem solved.—*Coal Age.*

LOSS BY SAVING AIR

To the student of combustion the perplexing question always is why coal users will continue to burn expensive coal and freight money when air is so cheap and makes a hotter fire? To suggest burning air seems like fathering one of those altruistic dreams which occasionally are inflicted upon the public. However, it is sound in principle and is the one thing really worth considering.

To illustrate what we mean: There is coming into use generally, in construction work, concrete or stucco. To make a first-class stucco requires one part of cement, three parts of sand and five parts of gravel. Sometimes the mixture is one, four and six respectively. Any man knowing that the first mixture is strong, would call the contractor insane who insisted upon using the expensive cement alone.

At the same time, to get proper combustion means a mixture of one part of coal and twelve to eighteen parts of air. It is just as foolish for a man who burns coal to think of getting the best results by using coal alone or with a very small amount of air as it is to build a house out of cement alone. Twelve parts of air to one part of coal will make a fire so hot that very few furnaces or grate bars will stand up against it. A mixture of eighteen parts of air with one part of coal will make, commercially, an economical and hot fire.

When air is so cheap and has such a tremendous influence upon coal combustion, we constantly wonder why men will try to burn coal without air and why the nation keeps on paying unnecessary millions of money each year for fuel when it could save those millions by simply forcing air into the fire box.—*Black Diamond.*

DANGER OF SPRAYING TO ALLAY DUST

To avoid the danger of causing an epidemic of hookworm disease through the sprinkling of mines, it is necessary to mix various substances in the water such as salt, calcium chloride, or ferrous sulphate. A 1 per cent. solution of ferrous sulphate or a 2½ per cent. solution of salt is quite strong enough. These solutions keep the roads damp for a longer time than water alone. The efficacy of the salt solution was proved in the Dolcoath epidemic, where the only mine unaffected was one where a considerable quantity of sea water came into the mine, and in mines on the Continent calcium chloride or ferrous sulphate have proved efficacious.

OXYGEN CONSUMED BY A LAMP

The most recent tests to show the oxygen-consuming power of a naked flame are some experiments in Scotland. A lamp burning oil consumed 1.13 cu. ft. of oxygen and produced 0.78 cu. ft. of carbonic acid per hour. The same lamp when burning tallow consumed 2.49 cu. ft. of oxygen and gave off 1.74 cu. ft. of carbonic acid in one hour. The investigators determined the candlepower of various lamps by photometry. An old lamp (naked flame) consuming 13.8 gms. of oil per hour averaged 1 cp. The kind of oil used, of course, affects the candlepower considerably. A miner's tallow lamp consuming 17.4 gms. of tallow per hour averaged, with uniform flame for 15 minutes, 2.3 cp. A lamp consuming 13 gms. paraffin wax per hour gave 1.6 cp.

PNEUMATIC APPLIANCES IN RAILROAD SHOPS

Mr. F. A. Stanley, "Western" Editor of the American Machinist, is making a remarkable record in writing up in detail the machine tool equipment of various shops visited in his territory. Perhaps one of the most valuable and interesting of the notable series of articles he has thus far produced was in the issue of March 7 and was devoted almost exclusively to pneumatically operated tools in the so-called "Katy" shops of the Missouri, Kansas & Texas Railway at Parsons, Kansas. The tools described are practically all of local design and construction and they suggest how in railroad shops more than in any others compressed air is constantly thought of when things are to be done and finds unlimited variety of employment. The article spoken of wastes no words but goes right at work with views and descriptions only selected portions of which we here reproduce.

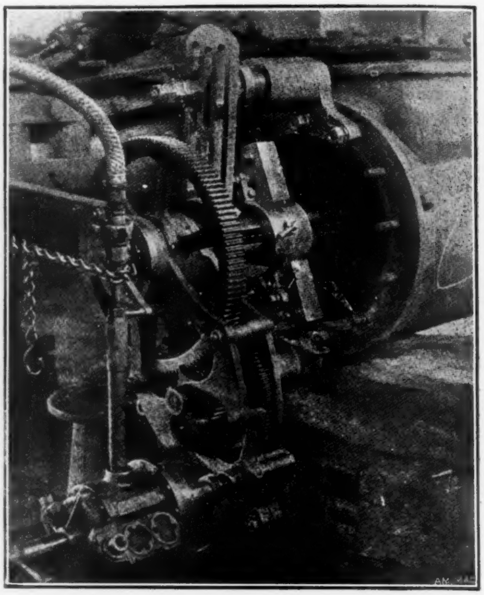


FIG. 1.

The devices shown are many of them portable, Fig. 1, showing a boring bar for reboring locomotive cylinders without removing them from the engine. The bar is mounted in bearings hung from brackets secured to the cylinder studs and the drive from the air-drill motor is transmitted through spur gears giving the desired speed reduction. The cutter head is fed along the bar by a screw with star feed.

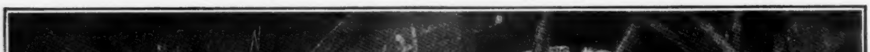


FIG. 2.

Upon the same cylinder even while the boring was in progress another air driven tool described in the article might be used for milling out the steam ports on the valve seat.

TURNING-OVER FOR VALVE SETTING.

One of the most tedious operations in the railroad shop, though not of daily occurrence, is the turning over of the driving wheels for the purpose of setting the valves. Before the entire valve motion is satisfactorily adjusted much time and labor are wasted if only human muscles are employed. The apparatus shown in Fig. 2 is the means of relief provided in the "Katy" shops. The rig consists of two pairs of small rolls carried by blocks which are placed in contact with opposite sides of the drivers and then drawn together by through bolts to lift the pair of wheels from the track. One of the rolls is corrugated and is carried on the end of a wormwheel shaft which is driven by a worm connected to an air-drill spindle as clearly shown. The corrugated roll thus serves as a medium for rotating the driving wheels, the three other rolls acting merely as supporting idlers. The wormwheel shaft has roller bearings at each end, made up of ⅜-in. rollers of soft steel, operating in a case-hardend bushing.

PNEUMATIC CLAMPS FOR DRILLERS.

Fig. 3 shows a handy attachment applied to drillers of various sizes for holding the work without loss of time in fastening and releasing the piece.

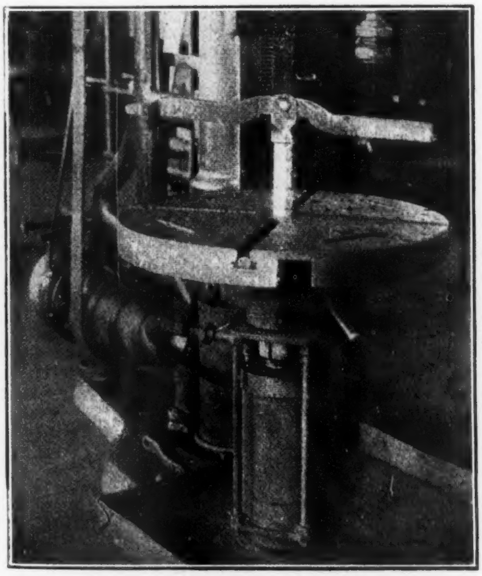


FIG. 3.

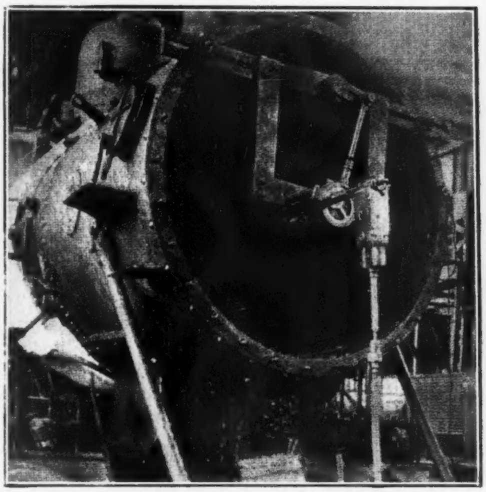


FIG. 4.

The air cylinder under this drill table has a 6-in. bore and the stroke is 8-in. The piston rod extends up through the center of the table and is forked at its upper end to carry a long clamp bar which is pivoted at the center. The piston and clamp are lifted to release the work by a heavy spring between the underside of the piston and the bottom of the cylinder. The work is clamped by air pressure upon the upper side of the piston.

OSCILLATING MACHINE FOR GRINDING-IN PIPE.

The appliance in Fig. 4 was constructed for grinding dry-pipes into flue sheets. The rotary motion of the air-drill spindle is transmitted by an eccentric to a rocker arm which oscillates a horizontal shaft extending inward to the pipe and carrying three radially placed pointed jack screws which are set up tight inside the mouth of the pipe. The screw points engage the pipe hard enough to cause the latter to turn to and fro with the oscillations of the rock shaft and the pipe is thus ground in to a tight seat in the flue sheet.

A HANDY TRAVELING DRILL.

The outfit in Fig. 5 forms a very convenient equipment for such work as the drilling of test holes in stay-bolts in boilers and for other operations where a lateral movement of the whole driller is desirable. The engraving represents the drill proper mounted in a metal

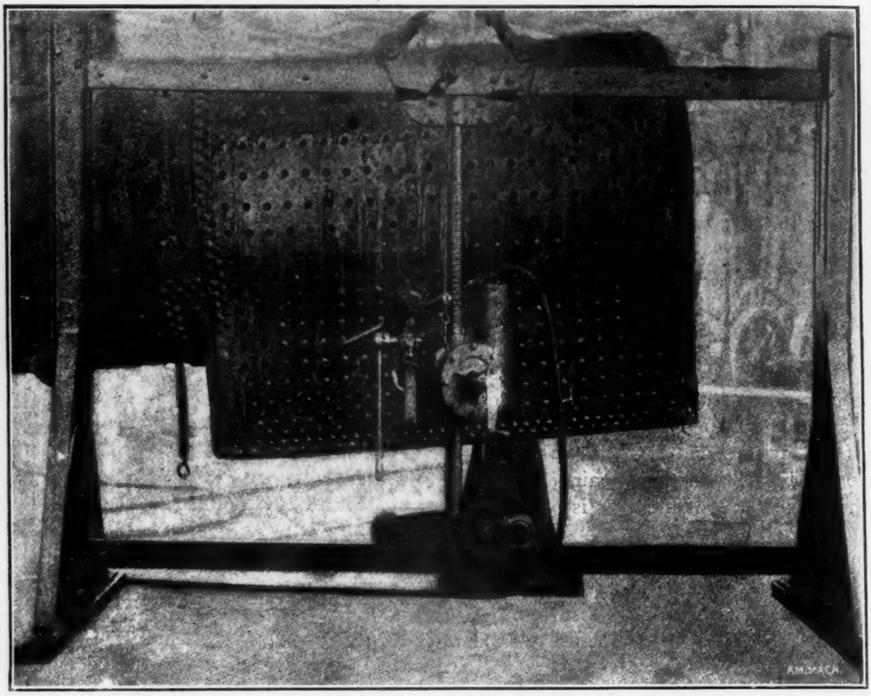


FIG. 5.

frame which provides upper and lower tracks for it to travel on over a distance of eight or ten feet. The whole affair may be picked up by the crane and moved to any desired point in the shop. The air drill is mounted at the end of a stiff shaft which is slid in its bearings by rack and pinion to feed the drill to the work and withdraw it for the next operation. The guide for this drill carrier is adjustably attached to a body which is mounted upon the threaded upright forming the driller column. Adjustment up and down the column is secured by a crank handle. The head is balanced by the counterweight shown. The drill is adjustable in every direction and is readily clamped at the necessary angle for any hole to be drilled.

ATTACHMENT FOR PNEUMATIC CHISEL.

The pneumatic chipping hammer in Fig. 6 is fitted up for cutting off stay-bolts in boiler work. As illustrated it is equipped with an attachment for holding a back jaw or anvil cut off with the chisel. In operation, the

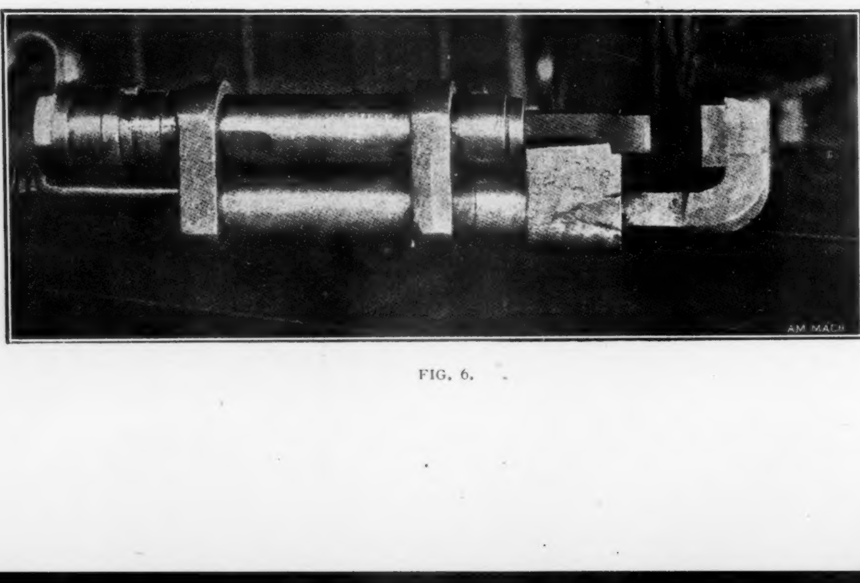


FIG. 6.

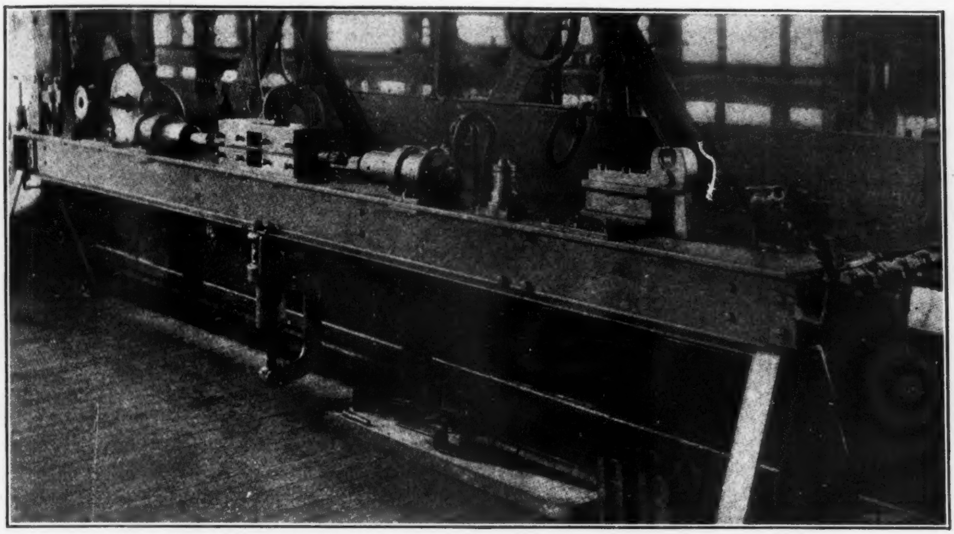


FIG. 7.

which is drawn up against the stay-bolt to be piece is cut nearly through with the chisel and then broken off with a blow of a hammer.

AIR HOSE TOOLS.

The view in Fig 7 shows a portion of the pneumatically operated equipment in the air-hose department. At the right-hand end of the bench there is a pair of cutting jaws for shearing the heads from rivets in the hose clamps. The hose is afterward split to release the coupling in the machine at the left end of the bench. Here the hose is placed in a V-block and the splitting chisel brought down to cut the end free from the connection.

The machine near the left end of the bench resembling a horizontal fan is a rotary internal wire brush into which the couplings as removed from the old hose are slipped for the removal of dirt and scale, this process fitting them for assembling in the new lengths of hose.

The apparatus at the center of the bench consists of a long vise in which the hose is gripped, and two air cylinders at the ends which supply pressure for forcing the connections into the two ends.

HANDLING SHEET METAL WORK.

The two machines in Figs. 8 and 9 are pneumatic punch presses for sheet-metal operations. The one in Fig. 8 carries sixteen 3-16 in. punches for piercing as many holes at each stroke in locomotive jackets of Russia iron. The other press pierces and blanks out a body for a tin torch.

In both cases the rams with the punches are operated by a pair of rocker arms connected by toggles with the air piston. It will be seen that the effect of this arrangement is to produce a complete down stroke and return stroke of the punch by a single stroke of

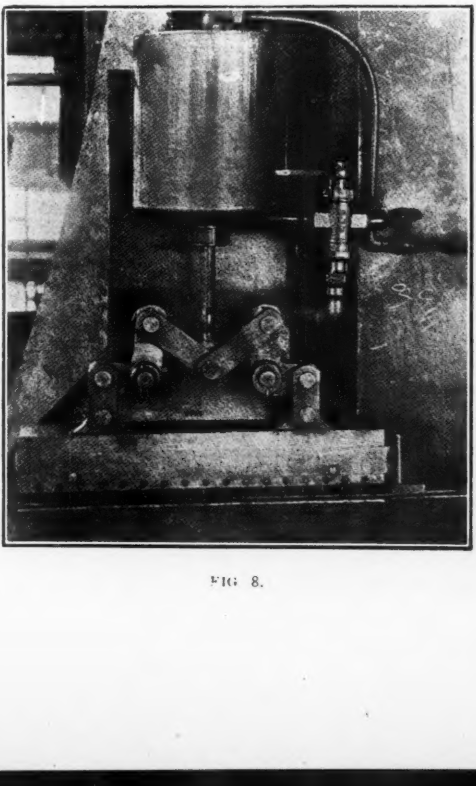


FIG 8.

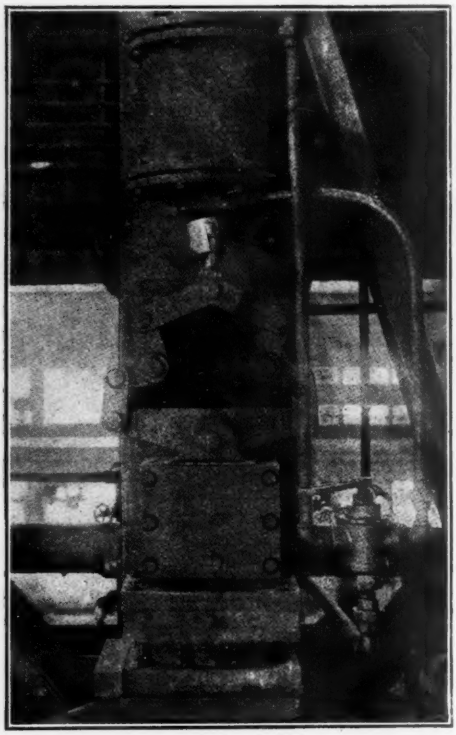


FIG. 9.

the piston in either direction. That is, as the piston descends the punch is forced through the work and then withdrawn. When the piston lifts, the punch is again moved through its down and up strokes. The range of movement is, of course, quite limited, but it is sufficient for the special work for which the apparatus was constructed. These air-operated presses are placed along the gallery structure where they occupy very little space that could otherwise be utilized by machinery, and they are found highly satisfactory for the classes of work for which they were built.

Three or four other pneumatic devices in the "Katy" shops have to do with the heavy leaf-springs employed in railroad construction. One is for placing the bands on the middle of the springs to hold them together, and another is for removing these bands. Still another device is for pulling down tank-truck springs to enable the through-bolts to be put into place. There are of course many other special air operated devices in the shops besides the regular line of pneumatic tools.

SMALL TUNNEL DRILLING AND BLASTING

An important change in the tunnel system of Rochester, N. Y., involved the construction of about a mile and a half of tunnels in solid rock with a 6 by 6 foot section. The tunnel work is described in a recent issue of *The Contractor* from whose columns we reproduce the following.

When the tunnel excavation was started from fourteen to sixteen, 8 to 10 foot holes were drilled in the 6x6 foot tunnel. Two Ingersoll-Rand air drills, mounted on columns, were used for this purpose. The holes were charged with dynamite and fired with a battery. About eight hours were consumed in drilling the holes, and two or three hours and occasionally longer in the blasting and waiting for the fumes of the explosive to blow away. A great deal of trouble was experienced with the explosives and their fumes, and considerable time was lost due to this. Although three shifts were worked, only two rounds of holes could be drilled and fired in twenty-four hours.

In order to improve on this, experiments were first made to procure a good high power gelatine dynamite, that would nominally be without fumes, the contractors realizing that considerable time could be saved in this way and some money. The Nitro Powder Company's special tunnel gelatine was adopted. It might be stated that all the so-called fumeless powders have some fumes when exploded, and it is always a matter of selecting the one with the least fumes. The less fumes emitted by a powder means a more effective blasting compound as the gas is used up in effective work, instead of being thrown off in the surrounding air, thus making the explosive quick and more powerful in its action.

Investigation was also made as to arrangement of drilling and firing holes. With a more powerful explosive fewer holes were needed, so what is known as the Hammer Cut method, used extensively in the western mines, was introduced. With this method only eight to ten holes were necessary, which allowed the drilling to be done with one of the Ingersoll-Rand drills, thus saving two men on a shift. The work being done to a great extent as a task, the foremen could be dispensed with, and instead, day and night blasters were employed.

In place of firing the holes by battery and exploding all of them simultaneously, fuse

was used. There are a number of disadvantages in driving small tunnels and headings and using a battery to explode the charges. When a battery is used, the number of holes drilled are from fourteen to sixteen and are so close in some tunnels that they must be fired simultaneously, otherwise one hole may rob the others. In the east, in a 6x6-foot tunnel or heading, the holes are often fired in three series. First, the center holes are shot, then there is a wait until the fumes and gases can be blown out, so that a man can go into the tunnel and connect up the wires to blow out the rib holes, after which there is another wait while air is blown in, and finally the breaking down or back holes are exploded. Thus three blasts are made to break about six feet of ground. Naturally, each charge exploding makes a dense volume of smoke that hangs as a body at the breast, making it necessary to blow out the smoke and fumes to allow a man to enter to make the next blast. If the tunnel is long or the work is in a confined space the time thus lost is considerable and the delay is not only to the blasters, but also to the drillers and muckers.

By the Hammer Cut method, where fuse is used, as previously stated, the number of holes is less, thus the drilling cost per cubic yard or per lineal foot of tunnel is nearly cut in half. The cost of loading and the cost of explosives is decreased. This is so, because the holes can be located and drilled differently. The rib holes can be entirely eliminated. As a rule, there are only needed three cutting holes, two or three lifting holes, two or three breaking down holes, and two back holes, in all from eight to ten holes; seldom more than ten and under favorable circumstances only eight.

When fuse is used, all the holes are lighted at one time, so that it is not necessary to enter the tunnel until the entire blast is over. In order to obtain the best results from the drilling and explosives, the different holes are exploded one after the other. This is accomplished by cutting each fuse to a different length, so that No. 1 hole is exploded first, No. 2 second, and so on through the eight or ten holes. If it is desired to explode two or more holes, as the cut holes at one time, the same length of fuse is used for each hole as two or more fuses located close to each other can be lighted by an experienced man in a few seconds. Each hole is given a number, the same length fuse used in the same numbered hole each time, and they are all lighted in the same order.

An experienced man is able to count the explosions and if one hole misses fire, he is able to locate it at once. This is not possible when all the holes are shot simultaneously or in series by a battery. Then, too, the concussion of the successive blasts, when fuse is used, helps to drive out the smoke and fuse, so that when the blasting is finished, the tunnel air is purified much quicker by means of the air pipes.

Sometimes in soft and seamy ground the seams will connect up part or all of the holes and the entire set of holes will explode simultaneously or at other times one hole will rob another or blow the charge out of an adjoining hole, and the dynamite will be found scattered around the heading. The experienced blaster will be able to tell these things by the reports of the blasts, and will exercise care in entering the tunnel, and if such seams continue, steps can be taken to prevent these things.

With fuse there is no danger to the man firing, and one man should do this, if possible. Good fuse burns at the rate of one foot in forty seconds, so that a piece ten feet long gives a man about seven minutes to light the fuse and get out of the way. The best evidence that there is no danger is that accidents do not happen in this way.

Another advantage in fuse blasting is that the cutting holes are blown first, throwing the muck well out in the tunnel, and then the breaking down holes exploding, throw their muck down and out, while at last comes the lifting holes, throwing the muck well out on the rest, thus nominally clearing the bottom so as to allow the drill column to be set up at once, and the pile of muck immediately behind the driller (gives him something to stand on, without time placing a scaffold) while he is drilling the upper holes, which for this reason should be drilled first. Then, as the muck is cleared away, the bottom or lifting holes are drilled.

The method described above was the one used by the contractors and they found that they broke as much ground as with the former method. The location of the holes and the mode of lighting the fuse is shown in an accompanying cut. During the eight months

that this method has been in use, the contractors have not even had a minor accident. Not only have savings been effected in time lost by fumes, in labor, number of holes drilled, dynamite, air, and in other ways, but in as much as the concussion from blasting of one hole is much less than when the holes were fired in series, no damage has been done to adjoining property.

The sixty per cent. Nitro gelatine, put up in 1⅛-inch sticks, was stored in magazines, that were heated by small boilers, which supplied heat to radiators that were properly protected. Thus, during the winter weather the dynamite was thoroughly thawed at all times, so that the best results were always obtained from it. The writer has seen dynamite used that was supposed to be thawed, when large chunks of it were not, and these did not explode, or a frozen core not much larger than a lead pencil would be found in the sticks. Thus the full power is not obtained and so money is wasted

Another feature of interest is the use of electricity on this work, thus eliminating many boilers, much smoke and labor. The Ingersoll Rand air compressor is electrically driven, and the tunnels are kept dry by Cameron pumps. At some of the shafts air hoists were used.

APPLICATIONS OF PNEUMATIC TOOLS

BY A. M. M.

There are many classes of work now done by hand to which pneumatic tools can be applied with advantage. Many plants have developed special uses for these tools, a few of which are here presented.

A contractor engaged in erecting large electric generators had several thousand tubular rivets, 1½ inch in diameter, which were to be headed cold. This was a very slow and laborious job. The rivets were used to hold together the laminations of the stator, and were drilled at the ends to make them tubular and to facilitate heading. By means of a beading tool and a hand-hammer, they could be riveted up in the same manner that boiler tubes are beaded, but it was found that not more than two per hour could be headed by hand. After considerable experimenting a 9-inch pneumatic riveter was fitted with a special die for the work, and the time was reduced to five minutes per head, with less fatigue to the operator.

Fig. 1, showing the die and rivet end, illustrates the idea. A common riveting die was turned to fit the finished head leaving a centering pin in the middle of the die. Two opposite sides of the die were then slabbed off on a milling machine, leaving the working edge about ⅜ inch. thick. This edge was filed round, and the die hardened. A hole drilled through the die provided means for attaching a piece of ⅜-inch round steel wire as shown. This served as a handle to rotate the die. The operator could form a perfect head on the bolt by slowly rotating the die, and working down the edges as desired.

DRIVING DRIFT-BOLTS IN CRIB WORK.

A contractor was building crib work of hard fine timbers, 10 inches square. He had several thousand drift-bolts to drive. The bolts were 8 feet long, and 1 inch in diameter. He had several gangs of three men each working from a staging, driving with heavy sledges. The three men would drive one bolt, striking alternately. The work was progressing so slowly that he determined to try a pneumatic riveting hammer. He found that a heavy riveter, operated by one man, would do the work of two gangs (six men), and dispense with the heavy staging.

PNEUMATIC HAMMER IN BROACHING OPERATION.

A machine shop had a large number of hexagon bushings whose inside surfaces had to be finished smooth and of accurate dimensions to make a close fit on a ¾ inch hexagon rod. A hexagon broach of the same dimensions as the rod was machined and the end squared off to a cutting edge. It was found very difficult to drive this tool through the bushing with a hand hammer, but it was easily and quickly accomplished by the rapid blows of a pneumatic hammer.

A PNEUMATIC WOOD-CUTTING TOOL.

It often happens that wooden hatches or decks are fitted with I-bolts or handles which must lie flat with the surface. To make room for the fingers or a rope under the ring, the wood must be cut out in the form of a cup or depression. Often, on a large job, there will be several hundreds of these cups to hollow out of the flat surface. A carpenter with his gouge and mallet will take a couple of hours to finish one, but the cutter here described, fitted to a pneumatic machine, will do this

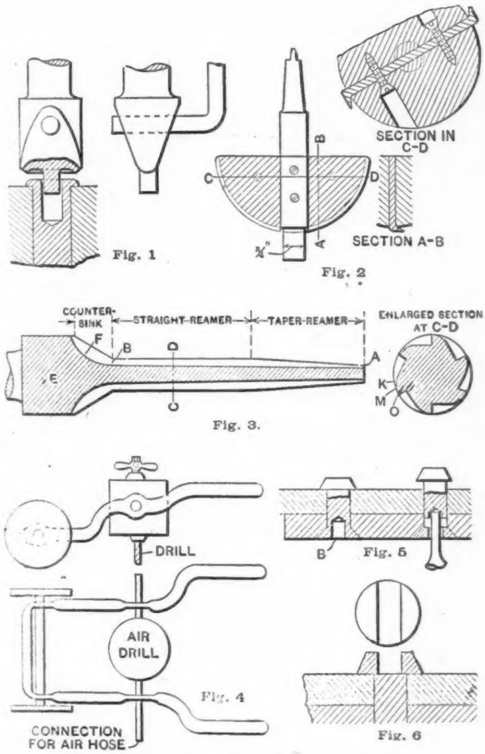
work in a few minutes. The cutter blade is formed of ¼-inch tool steel plate, set into a slotted bar and brazed. After this operation is completed, a block of wood, turned in a wood lathe to the shape of the cup, is fitted to it as shown in Fig. 2. This block allows the cutter to project beyond its surface, and prevents it from taking too large a chip. The tool works best in one of the smaller machines of high speed. A ¾-inch guide hole is first bored to the required depth.

SPECIAL REAMERS FOR PNEUMATIC TOOLS.

In a plant handling structural or steel ship work, the reaming and countersinking of the thousands of rivet holes is a large item, and may represent a considerable percentage of the cost of construction. It is important that the reamer with which this work is done shall have certain properties. It must cut rapidly, without heating. It must clear itself when forced, without breaking. It must stand the abuse of unskilled labor. Two men with an ample supply of sharp correctly made reamers will ream several thousand holes per day, where they will only ream several hundred if obliged to work with reamers which do not cut properly. The following description and illustration, Fig. 3, shows how one of the large shipyards increased the efficiency of this operation several hundred per cent. by giving careful attention to these points.

This yard had a million, more or less, ¾-inch rivet holes to be reamed and countersunk. The work was started with the ordinary pneumatic reamers and countersinks, making two separate operations. The tool-room, having only a small supply of these tools and having other troubles, was very "economical" in handing out reamers, and kept the men working with the tools long after they were too dull to cut properly. The consequence was that the men would keep a reamer turning in one hole for several minutes, and not only did it not work, but the reamers were burned. The men made no attempt to rush the work as this only resulted in burned reamers and a "call-down" from the tool-room.

The following system was adopted with an increase of about 500 per cent. in the amount of work turned out. A special combination reamer and countersink was designed as shown in Fig. 3. Enough of these tools were



APPLICATIGNS OF PNEUMATIC TOOLS.

provided to allow about four reamers per gang. The gangs were put on piecework and one skilled operator in the tool room was made responsible for keeping the reamers sharp. Each gang was given a can of tallow on which to lubricate the reamer as often as required.

A "WHEELBARROW" DRILL MOUNTING.

The gangs working on the flat decks were cut down to one man, and this man was provided with one of the wheelbarrow devices shown in Fig. 4 in place of his helper. The countersink reamers insure that the countersink will be concentric with the reamed hole, and the whole job is done at one operation.

CUTTING OUT RIVETS.

An easy way of cutting out countersunk rivets is as follows: First drill a hole as shown in Fig. 5 at *B*. Then use a backing-out punch made to fit a pneumatic riveting hammer. If a good backing is available, a pneumatic "jam hammer" can be used to advantage. For cutting off rivet heads proceed as in Fig. 6, using a pneumatic chipping hammer and "cape" chi-

sel. First cut a slot through the head making it like a slotted screwhead. The two sides can then be cut off without trouble. Adapted from *Machinery.*

VARIOUS PNEUMATIC DEVICES

In the cut upon the opposite page are collected a number of pneumatic devices which have recently appeared in our exchanges.

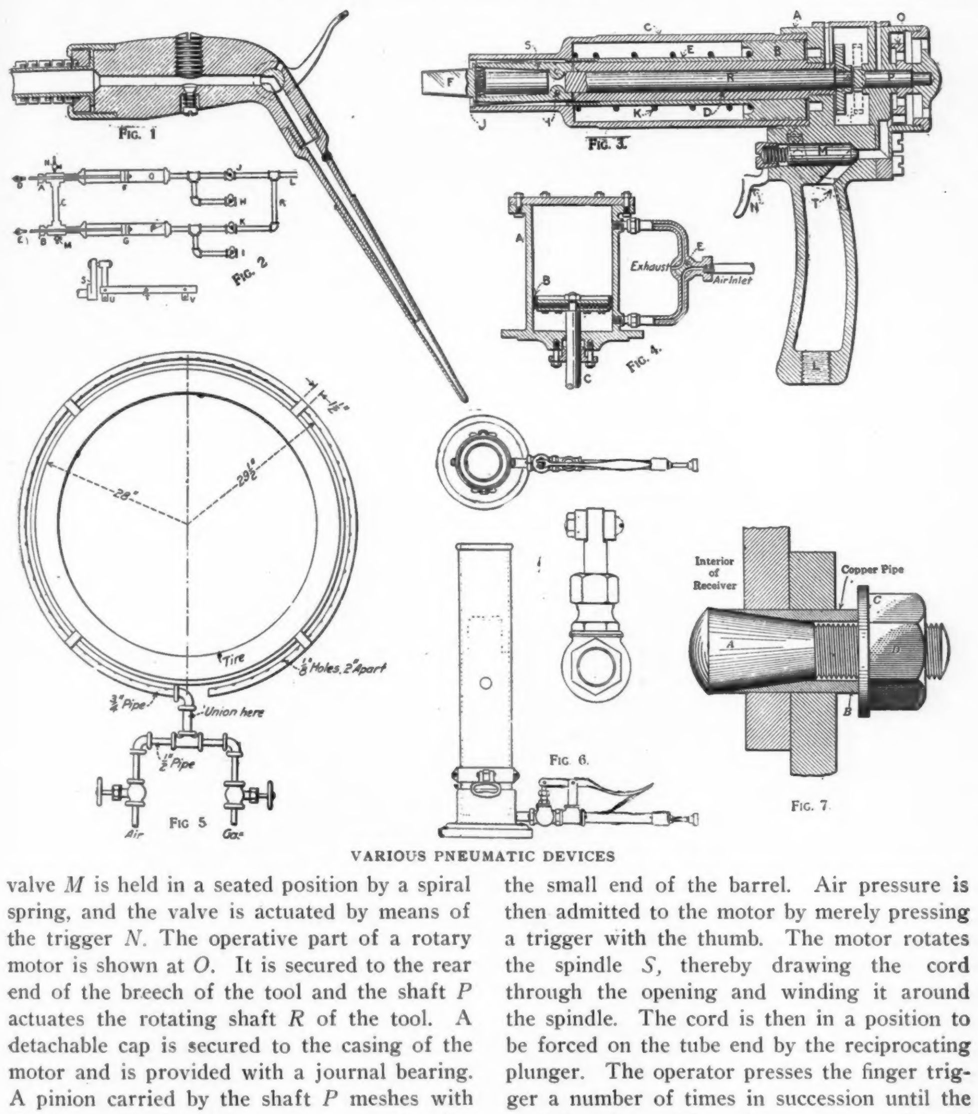
Fig. 1, from *American Machinist,* may be called a vacuum pick-up. In manufacturing jewelry and miniature marquetry work known as "articles de Paris" there is sometimes a quantity of small light parts of ivory, gold, silver or wood to be handled that are so thin that pincers may spoil them. A very handy way to pick them one by one without deformation is to use vacuum. For infrequent service a rubber bulb as used by photographers, provided with a tubular nozzle, is sufficient. But for regular work the following arrangement has been found satisfactory. A small electrically driven blower is used to create 6 to 10 inches of water vacuum in suitable piping. An armored rubber tube connects to the nozzles provided with a three-way cock. By pushing the cock handle, air is pumped through the nozzle and by having the latter of suitable size, pieces as small as 1-32x1-32x0.001 inch of silver can be handled. Pulling the handle breaks the vacuum in the nozzle and the piece is free. For such small pieces as mentioned above, 6-inch vacuum is too much to allow them to be picked up one by one from the pile in the right position; hence, the small valve in the handle is added to regulate aspiration while separating the points. The nozzle is made large enough to accommodate the largest pieces to be handled, and several adapters are provided; these being simply tubes fitting the nozzle and having various sizes of holes.

A HOME MADE AIR COMPRESSOR.

Fig. 2, from Popular Mechanics, shows a cheap and quickly made air compressor which might serve for experimental or temporary service. It will produce some 50 lb. pressure in a tank and is made with two cast iron open well pump cylinders, 2½ in. inside diameter, and common pipe connections. These cylinders can be purchased cheaply, complete, including guide rods and plungers. Packing boxes, A and B, from old discarded valves are fastened into the tee connections on the end of the pipe C. The valve rods D and E pass through the packing boxes and are attached to a device for driving the pistons F and G. The pipe connections on the ends of the cylinders have two inlet check valves, H and I, and two outlet valves, J and K, to the pipe L attached to the tank. A crank arrangement can be fixed to operate the compressor from the end of a shaft as shown in the lower sketch. The crank S operates an arm pivoted in the center at T. The plunger ends D and E are attached to the projections U and V.

CONDENSER PACKING TOOL.

Fig. 3 from *Power,* shows a novel and ingenious device for packing condenser tubes. Operated by compressed air, it winds the packing cord around a spindle and then pushes it into position around the tube, both operations being controlled by the thumb trigger. The body part A is integral with the handle. The barrel is made with a reduced outer end, and the parts are secured by screw threads, as shown. The tubular reciprocating plunger *E* is provided with a piston *B* which accurately fits within the barrel *C.* A rotary shaft fits within the inner guide tube and is provided with an enlarged journal bearing at its outer end. The end of this enlarged part is turned down into the form of a frustum of a cone, as indicated at *F,* and is provided with a shoulder which fits against the end of the tubes around which the packing is to be inserted. This enlarged part also constitutes a cylinder around which the packing cord is wound before the tool is put into use. To secure this cord a longitudinal groove is provided in the body part in which is pivoted upon a pin *H* a longitudinal finger *J.* It is grooved at its outer end and has a spiral spring inserted in a hole, the arrangement being such that normally this finger is held at its outer end against the inner face of the small end of the barrel. The spiral spring *K* is for the purpose of returning the reciprocating plunger to its normal position after it has been actuated by the compressed air. A longitudinal slot at the small end of the barrel constitutes an opening for the insertion of the packing cord. The air supply is conducted to the handle of the tube through a rubber tube. In the bottom of the handle is an opening *L* which runs to the body of the valve where it is divided into two channels, one conveying the compressed air to the piston and the other to the driving motor. The



VARIOUS PNEUMATIC DEVICES

valve *M* is held in a seated position by a spiral spring, and the valve is actuated by means of the trigger *N*. The operative part of a rotary motor is shown at *O*. It is secured to the rear end of the breech of the tool and the shaft *P* actuates the rotating shaft *R* of the tool. A detachable cap is secured to the casing of the motor and is provided with a journal bearing. A pinion carried by the shaft *P* meshes with the gear wheel which rotates on a bearing journal that is secured to the breech. Another pinion is carried by a shaft integral with the gear wheel and meshes with a second gear wheel that is secured to the rotary shaft *R*. A second valve is kept seated by the pressure of a spring in the channel running to the rotor of the motor. This valve is operated by the lever *T* which is worked by the pressure of the thumb. Air vents are provided for liberating the air after it has passed through the motor. When using the tool one end of the cord is inserted at the outer end of a slot at the small end of the barrel. Air pressure is then admitted to the motor by merely pressing a trigger with the thumb. The motor rotates the spindle *S*, thereby drawing the cord through the opening and winding it around the spindle. The cord is then in a position to be forced on the tube end by the reciprocating plunger. The operator presses the finger trigger a number of times in succession until the cord has been driven home, the number of blows depending upon the density to be given to the packing. In this way the operator passes from one tube to another in quick succession. The average operator can easily pack a condenser at the rate of from 10 to 15 tubes per minute, and as many as 28 tubes have been packed per minute. This instrument was invented by Edward P. Strode, 131 E. 30th St., N. Y.

AIR POWER FOR STEAM VALVES.

Fig. 4 is to be regarded as merely a suggestion from a correspondent in a recent issue

of *Power.* The writer says: "Most modern power plants are provided with air compressors and many of the larger valves might be operated by means of air. The sketch shows my idea of this means of application of air. The appliance consists of a cylinder *A*, bolted to the upper flange on the valve body; a piston *B*, fitted to the upper end of the valve stem *C*, which is packed, as shown and a four-way cock *E* connected by means of unions to the cylinder *A*. The illustration shows the position of the piston when taking air underneath and exhausting above the piston *B*.

LOCOMOTIVE TIRE HEATER.

Fig. 5, from *Railway Age Gazette* shows a cheap, handy and effective tire heater using gas in connection with compressed air. The circular portion is made of ¾ in. pipe, with ⅛ in. holes, spaced 2 in. apart, on the side toward the tire. There should be a sufficient number of these circular parts to take care of the different diameters of tires; it is not a good plan to open the pipe out for use with larger tires than it was intended for, as bending it back and forth soon causes it to break. The union which connects the air and gas pipes allows the ring to be detached and changed. Gas is used at a pressure of about 45 lbs. per sq. in. and air at about 75 lbs. per sq. in. In operation the piping which connects to the ring is at right angles to the position shown on the drawing.

AIR SLEDGE.

Fig. 6 is a sketch of a home-made air sledge described by Charles Markel, shop foreman, C. & N. W. R. R., Clinton, Iowa, in Railway and Locomotive Engineering. It is made of a 4-in. pipe about 2 ft. in length and operated by a globe valve furnished with a lever-operated valve, which gives quick opening to the air inlet and automatically closes by a spring attached under the handle. This sledge has proved itself to be every effective in removing refractory bolts, and is much valued by the men of the wrecking crew, as it has been very effective in removing draw-bar pins where the tender and engine were jammed together. The device has the double merit of being simple in construction and operation.

STOPPING LEAKS IN AIR RECEIVERS.

The device shown in Fig. 7, we regret to say, we are unable to credit to its source as our record of it is mislaid. A convenient method of stopping leaks around a loose rivet in air receivers or steel water tanks, or even for emergency repair work on boilers, and one which can be made entirely from the outside is to use a taper bolt with copper sleeve, as illustrated in the accompanying sketch. The head of the faulty rivet is cut off, and the rivet knocked out of the hole, or else the rivet may be drilled out. A taper bolt *A*, large enough to pass through the hole, and threaded up to 1½ in. of the large end is inserted in the rivet hole and a piece of copper pipe *B*, of the same internal diameter as the diameter of the bolt, is lipped over the threaded portion of the taper bolt; it should project ¼ to ⅜ in. on each side of the plates. A washer *C* and nut *D* are then put on and the nut screwed up with a long-handle wrench. The bolt can be used for withstanding pressures up to 200 lb. per sq. in. with safety. The bolt may be used for repairing other small leaks such as may occur in pump columns by drilling out a hole at the point where the leakage occurs. A variety of uses for such a bolt will be suggested by the sketch.

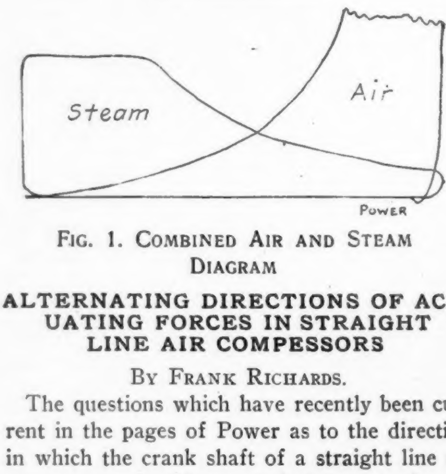
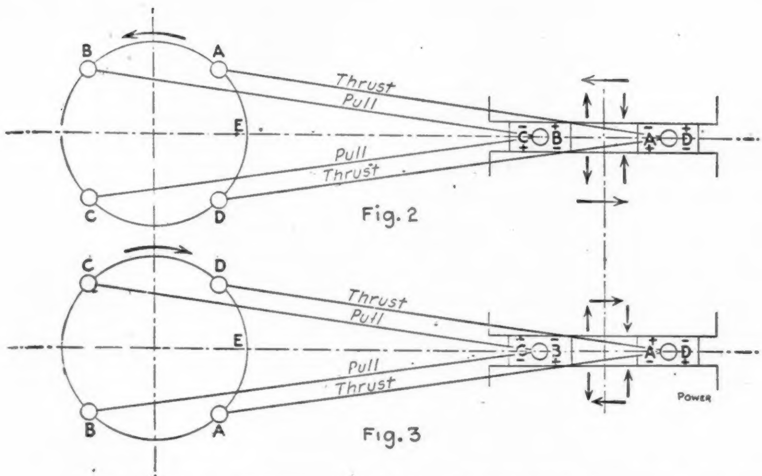


FIG. 1. COMBINED AIR AND STEAM DIAGRAM

ALTERNATING DIRECTIONS OF ACTUATING FORCES IN STRAIGHT LINE AIR COMPRESSORS

By FRANK RICHARDS.

The questions which have recently been current in the pages of Power as to the direction in which the crank shaft of a straight line air compressor should run, and also as to the peculiar knocks sometimes accompanying the crosshead movements in compressors of this type, suggest that something might be done toward the securing of a clear and final understanding of the matter, and accordingly I have prepared the accompanying layout, such as I believe has never been done before, and which I hope may help to straighten out the matter. I am aware that the thing is not of



FIGS. 2 AND 3. REPRESENTING GRAPHICALLY THE PRESSURES ON THE CROSSHEAD AND PIN

great importance—althought it is curious and interesting—and for that reason it would be well to get it out of the way.

We all know that in the horizontal steam engine if the crank shaft runs "over" the crosshead pressure is always downward, while if the crank shaft runs "under" the resultant vertically acting forces at the crosshead are reversed, and usually more than sufficient throughout the stroke to overcome the weight. In the air compressor the conditions are very different, no matter which way it runs.

In the typical combined air and steam diagram, Fig. 1, which might be from any straight line compressor, the cylinders being assumed to be of equal diameter, we see that in the earlier portion of the stroke the steam pressure is greatly in excess of the air resistance, and the surplus of the power must be disposed of in increasing the momentum of the fly wheels. At the point where the steam expansion line and the air compression line cross, the pressure in the steam cylinder just equals the resistance in the air cylinder, and beyond that point to the end of the stroke the steam pressure must be assisted by the momentum of the fly wheels. The inadequacy of the steam to maintain the running really begins before the point is reached where the lines cross, because there is the entire friction of the machine to be overcome and the running speed to be maintained, so that we may see that the actual reversal of the balance of the driving forces occurs very near midstroke, no matter in which direction the crank shaft turns.

The story of what happens is told graphically in Fig. 2 and Fig. 3 and it would seem that, little explanation should be required. In Fig. 2 the shaft runs over and in Fig. 3 it runs under. At the crosshead + indicates that it is pressing the slide while — shows the reverse. The vertical arrows at each side of the midstroke line show the vertical thrust of the crosshead for that portion of the stroke.

It will be seen that there is but one reversal, and back again, of the connecting rod stress for the revolution. Running in either direction there is a thrust for about one half of the revolution and a pull for the other half. The crosshead, however, shows four consecutive reversals of vertical thrust for each revolution. If there is any conclusive reason why the crank shaft should turn in one direction in preference to the other the writer has failed to discover it.—*Power.*

Leakage in subaqueous tunnels in gallons per 24 hours per lineal foot of single bore, was recently stated by Mr. W. J. Wilgus to be as follows: North River tunnels of the Pennsylvania Railroad, 0.15; Detroit River, 0.85; East Boston, 1.35; East River tunnels of Pennsylvania Railroad, 1.00 to 2.00; North River tunnels of Hudson & Manhattan Railroad, 2.28 Battery tunnel of New York subway, 1.68; Sarnia, 2.46.

TESTS OF TURBO COMPRESSORS

Tests of rotary air compressors of the Rateau or turbine type, built by Pokorny & Wittekind Maschinenbau A.-G., of Frankfort-Bockenheim, Germany, were noted in London *Engineering* of Dec. 15, 1911. The first of these was built in 1909 for the Reden mines near Saarbrücken. It is driven at 4200 r.p.m. by a 1000-hp. mixed-pressure steam turbine. The tests were conducted by Prof. Lander, of the Aachen Technical High School. With 264,900 cu. ft. of free air compressed per hour from one to seven atmospheres (99.6 lb. absolute), the consumption of exhaust steam (taken at 15.6 lb. absolute and discharged at 1.14 lb.) was 7.98 lb. per 100 cu. ft. of free air and with this also was used 5.05 lb. of live steam (at 85 lb. absolute).

The second compressor was built for the Könnigsborn A.-G. für Bergbau, Salinen und Sodabetrieb, at Unna-Königsborn, Westphalia. It is driven by a 1000- hp. mixed-pressure turbine and has six wheels in the low-pressure group with seven in the high. There is an intercooler between stages, and between each impeller wheel is a water-cooled partition. Air is discharged at 60 to 70° C. Prof. Lander's tests showed that with 287,000 cu. ft. of air compressed per hour from atmospheric pressure up to about 114,000 lb. per sq. in. absolute, 7.74 lb. of exhaust steam (taken at 17.7 lb. absolute and discharged at 1.47 lb.) was required per 100 lb. of free air together with 4.54 lb. of live steam (at 103 lb. absolute). The isothermal efficiency of the compressor was from 64 to 65 per cent. Tests were also made on one of six 4000-hp. motor-driven compressors of this type, built for the Rand mines in Johannesburg, South Africa. It had a capacity of 1,250,000 cu. ft. of free air per minute (from 11.8 lb. absolute to 128 lb., air being taken at about 20° C.). The compressor is in two sections, each shaft being driven by a 2000-hp. 3000-r.p.m. synchronous motor. The shafts are parallel and there are two low-pressure compressor sections on each shaft. One shaft also carries the intermediate stage and the other the high-pressure stage. When compressing 1,425,000 cu. ft. of free air per minute to 115 lb. absolute, the energy consumption per 100 cu. ft. of free air was 0.301 hp. The highest "isothermal efficiency" secured was 67.7 per cent.

DIFFERENT UNITS OF MEASUREMENT

Scientists use a unit of space depending upon the magnitudes of the things with which they are dealing. If they are interested in very small things, they use the cubic centimeter or cubic inch. If they are engineers, engaged in making excavations such as the Panama Canal, they use the cubic yard. If they are geologists, considering the volume of the continents and oceans and how the continents are washed into the oceans, they use the cubic mile.

The largest unit in use by scientists is that which astronomers employ when they measure the celestial spaces. Their unit of volume is a sphere whose radius is 200,000 times 100,000,000 miles. The volume of this unit is approximately the radius cubed and multiplied by 4. The number of cubic miles in this unit is therefore represented approximately by 3 followed by 40 ciphers.

Obviously, the reason astronomers use such an enormous unit of space is that the volumes with which they deal are very great. But one might ask if this unit is not much larger than is necessary. Indeed, it is scarcely thinkable that it would not include the whole universe. If such a sphere were constructed with its center at the sun and its surface out in every direction to the distance of 200,000 times 100,000,000 miles, one might ask if it would not contain within its limits the North Star, the Pleiades, the Milky Way, and all the other stars that fill the sky. The astonishing answer to this question is, however, that there would not be another star in it besides the sun. Most of them are hundreds of times as far away from us as the surface of this immense sphere would be. The appalling magnitude of the universe is indicated by the fact that there is, on the average, but one star in seven or eight of these enormous units of space, though through the great modern telescopes the stars seem literally to fill the sky.

The tunnel continuing the Jungfrau railway from the Eismeer station to the Jungfrau Jock "saddle," which is 11,400 ft. above sea level, was recently "holed through." The tunnel emerges only about 2000 ft below the summit of the mountain and it is expected that the railway to the top will be completed in about three years.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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CONTENTS

BUSINESS LONGSIGHTEDNESS

The rock drill from the beginning of its modern and successful career in mining and tunneling work, has been almost entirely the creature of the air compressor. The builders of the one quite naturally became the builders of the other also, and the business in both lines has grown, with one firm at least, to enormous proportions, and with every assurance of not only permanent but also of continually increasing activity. Quite naturally there should be great unwillingness to interfere with the strong, deep flow of such an established business.

The air driven rock drill has had no successful rival in its special field up to the present time, and it might be expected that if one should appear every known defensive device would be arrayed to resist the attack, and aggressive measures for its annihilation might be looked for. Electricity with its omnivorous and pushing instincts has continually sought its share in the rock cutting work, but with little promise of success by any direct attack. All that has been required to be done defensively by the air driven rock drill and the air compressor interests thus far has been to leave it alone.

But the electric air drill, which now comes upon the stage, is an entirely different proposition from any which have preceded it. This is a mechanical compromise with no surrender on either side. The drill piston in the electric air drill is actuated by air pressure as completely as any drill piston ever was, but the motive power behind the air is electric and the big air compressor is ignored and forgotten.

Talking now only of the apparent possibilities of the case, the coming of the electric air drill must have meant something ominous to the established workers in the older lines. It apparently threatened a revolution in methods of working and a superseding of the old line of machinery, with all which this might mean to the manufacturers who had hitherto supplied the market. In the presence of the new drill the old central compressor plant is useless, and how must it strike the compressor builder?

Valuable and revolutionary inventions have before this been killed, or held back for years, in the interest of established businesses, and we might well believe that in this case the temptation may have appealed with force. The

patents are secure and ample to cover completely all the essential features of the new system, so that, as new inventions go, and as the inventors of disturbing things are apt to know, it would have been a simple and an easy matter to have first obtained control and then to have put the whole thing, not where it would have done the most good to those it was fitted to work for, but where it would have done the least harm—or none at all—to firmly established manufacturers.

Nevertheless, in this case, the builders of the old are the builders of the new, and they are apparently going into this branch of the business and pushing it, as is their wont, "for all it is worth."

There are of course different ways of looking at this. There are those, we know, who would regard it as an exhibition of business folly or short-sightedness, who would have thought it much the wiser to have held securely the business already in hand, the current apparatus already doing well enough for all concerned, and there being no question as to the continuance of reasonable profits.

The other view is, after all, undoubtedly the correct one. A manufacturer, or any business man, must in the long run be true to the permanent customer. When a firm has gone along for years continually making its product more efficient, reliable, desirable, the only thing for it is to keep on doing so; and though the possible changes as they come along may seem quite revolutionary, if they bring the same promise of increased efficiency that fact should determine their adoption.

After all, the result may be that the new drill will not to any great extent drive out the old, but will make a new field of employment for itself, and in that way lead as usual to a considerable enlargement of the already enormous business which is behind it.

AIR PISTON LEAKAGE

Editor Compressed Air Magazine.

For the benefit of engineers, mechanics and readers of your valuable paper who might gain a wrong impression, and with all due respect to Mr. E. A. Rix, I wish to take exception to a statement in that gentleman's article in the March issue, entitled "Operation of Air Compressors."

Under the sub-heading "Piston and Piston-rod leakage," it is stated that no piston is ever tight in an air compressor even when it is new and fitted with the best of rings. The author seeks to prove this by applying pressure on one side of the piston and observing the flow from the other side.

In the first place, two surfaces, properly lubricated and passing over each other at considerable speed will be perfectly tight, while they might permit considerable leakage at low speeds or when standing still, so a standing test is no indication of the working tightness of piston rings. This is well shown in fully balanced steam valves, particularly of the solid slide type, which require a long travel and a high engine speed, under which conditions they will be dead tight but decidedly leaky at slow speed. Time is an important element in the matter and it should be considered that in a single stage machine at 100 pounds and 150 r. p. m. the high pressure exists against the piston rings but 1-15th of a second, roughly speaking.

Another illustration of the importance of surface speed is the perfect tightness of the construction used on Prof. Sweet's Straight-Line engine—simply a long sleeve of excellent workmanship through which the rod passes without packing of any kind.

I would also say that it is entirely practical to make piston rings which will be tight when standing—a proof of which is seen particularly in many high-grade automobile engines which will hold high compression for several hours standing. Both the cylinders and rings are, of course, ground.

While it is not usual to grind the cylinders of air compressors, the rings should be ground, and if properly designed and manipulated in the shop a perfectly tight operating fit will result.

The writer has designed compressors with single acting high pressure cylinder for 400 to 600 pounds pressure which operated with no leakage which could be detected.

Erie, Pa. H. EDSIL BARR.

The Draeger helmet used on the U. S. Mine Rescue car No. 1, was recently given a severe under-water test in the swimming pool of the Y. M. C. A. at Pittston, Pa. On the first trial the demonstrator remained down eight min-

utes; on the second $12\frac{1}{2}$ minutes, and on the third 21 minutes and 40 seconds. The last figure exceeds considerably the unofficial record for such a test of 17 minutes, as listed in the records of the department.

CONTRACTOR EXPERIENCE

The most I ever learned about handling sewer jobs was from old Tom Maloney, and he couldn't read or write. He was a man that could do as much work with a shovel as two ordinary men, and I used him to pace the crew on one job. One day I went to him and I says: "Tom, you are a man I think will make a good boss. Tomorrow I am going to put you up on Seventh street in charge of the gang." That old son of a gun says: "If it is at all the same to you, Mr. Connor, I don't want the job. If you want to take me away to some other place where I am a stranger. I will take any job you want to give me. Right here everyone knows me and the gang would all quit the minnit I says to them I am the foreman. I will go up on that job if you like to put it out on station work, though. I will take it that way." I wasn't ready for station work on that job, for there were things coming up that I wanted to save for the men to hold them, so I told him that I would wait awhile and he could keep on where he was. Then the next day he said to me that if I thought he was a good enough man to be a foreman, and as he was doing the work of two men now, he thought he ought to get two men's pay. That is what I got for swelling the head of an ignorant man. Of course, I never gave him the raise, and at the next meeting of the council Tom walks in and takes away a contract that I thought was mine and had kept everyone else away from. Then he hires away my best men to work for him on it.

It was only a small job, but it looked like it would break me up on my time limit, and besides it left me only scrubs, for Tom put every man to work that wanted to work and put them all on station work, too. So I goes around and talks with him and finds he stands better in the town than I thought he did and he owned a lot of property, too. You see, he went there when there was no town and just stayed and saw it grow up around his farm. He had the work habit, and because he had to work he took pick and shovel jobs, and his wife and kids had got used to it, for he was mighty stubborn. So I fixes up a deal with him and soon the firm of Connor & Maloney was doing all the sewer work in that town. We did it for three years, too, when the old man died. During all the time he was managing the work for me one of his kids kept the books and I only showed up in town twice a year. You see, the old man had only hiredman's blood in him, after all, and thought all the time that I was the boss, when, as a matter of fact, he was the sole contractor and all I did was to go around and eat melons when he cut them. There was that fine old chap who could not read and write and with a mighty big brain and lots of hard-headed horse sense who might have been a big contractor if he had the guts. He was a good one, but had to have some one over him to rely upon.—*The Contractor.*

RESUSCITATING THE ASPHYXIATED

The pulmotor is an apparatus for forcing air or oxygen into the lungs of an unconscious patient to compel inspiration and consequent aeration of the blood. This seems to be simple, and is. In fact, the Commonwealth Edison Co., of Chicago, utilized a vacuum cleaner mechanism to produce the pressure, connecting the vacuum side with the air supply and the exhaust side by a tube with a mouth and nostril mask applied to the face of the asphyxiated patient. A device is also provided to keep the tongue out of the way. Between the mask and the air pump is a valve operated electrically by timing clockwork so that the operation of filling the lungs and permitting the air to escape is repeated automatically every three or four seconds. This is known as the Richter system and is packed in a box the size of a suit case. All it needs is to be connected to the electric light circuit and the patient.

A similar device has been adopted by Mr. Gross, of the Washington gas company, following the same idea of German origin. This pulmotor consists of a flask of compressed oxygen which is used instead of air and is quicker in its action. The operation is the same as with the Richter apparatus, except that two bellows were used to force gas into and take it away from the lungs. Dr. J. A. Holmes,

of the United States Bureau of Mines, has used this apparatus with great success in cases of accidents in mines.

The purpose is to forcibly continue respiration after the muscles lack the strength to do so, and the idea is as logical as the results are successful. The method is not confined to gaseous asphyxlation, but is useful in drowning cases or in reviving those rendered unconscious by electric shock. No manual labor or artificial rib motion is necessary; the pressure of the oxygen fills the lungs and when the pressure is released the natural elasticity of the lungs expels the used gas. Thus an emergency device could be simply a small oxygen flask, the valve of which is operated by hand, a nose and mouth mask and device to keep the throat open.

There have been a number of remarkable rescues made by this method recently. On Feb. 15 four Chicago victims were revived. One case required 4½ hours before there was any sign of life, and after two more hours of this forced breathing the man took up his bed and walked. Cases generally require from one to three hours' treatment. This was the 44th case revived by the Edison company in Chicago, the victims of gas asphyxiation in five cases having ceased breathing altogether. Most of these cases were traced to imperfect gas fixtures, although 10 were attempts at suicide found almost dead. The company places this rescue work at the people's disposal, advertises it and gets much favorable publicity thereby. Here is an opportunity for gas companies to make friends with the people and protect them, as well as their own employes, from untimely dissolution.—*Progressive Age.*

ANKYLOSTOMIASIS AT LINARES, SPAIN

There are about 200 lead mines in the district of Linares, Spain, but owing to the depressed condition of the lead industry, only about 35 of these are at work, and in 20 of them ankylostomiasis is prevalent, says *Revista Minera.* The number of persons employed underground is about 2500 to 3000 and of these it is estimated that about 10 per cent. are affected. Conditions are favorable for the propagation of the parasite, as the lodes worked are in wet granite, and most of the work is being done at a depth of about 1500 ft., the temperature varying between 80 and 86° F. All the usual symptoms of the disease are noted among the miners, and newcomers to the mines have been found to succumb to the disease within 12 months. It is stated that up to the present no sanitary precautions have been taken either to alleviate the infection or to provide against it, but *Echo des Mines,* Feb. 15, 1912, says that the Spanish government is about to take up the matter.

SOLID AND PNEUMATIC TIRES

No single pneumatic tire, even of the largest diameter, can be expected to carry a load of more than 1,350 pounds. Experiments have been made to discover the relation existing between the lasting power of a tire and the weight it supports, and from the results of a great number of tests has been deduced the following empiric laws: "The mileage of a tire is inversely proportionate to the cube of the weight it supports."

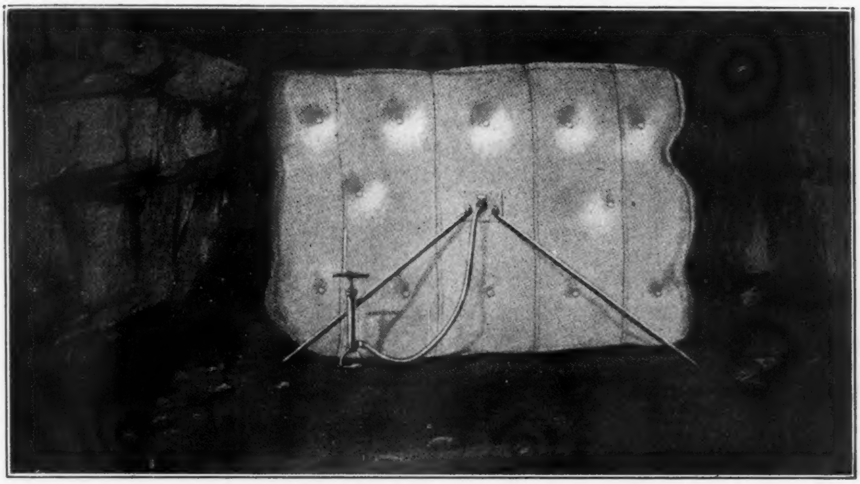
Thus if the weight is doubled, the wear will be approximately eight times more rapid. If the weight be increased by even so little as 5 per cent, the wear on the tire will be increased about 14 per cent. Thus, as soon as the weight is increased, it is discovered that the tires wear out with extreme rapidity. Accordingly it has been impossible up to the present to make use of this wonderful spring of compressed air. The solid rubber tire has been retained simply to lessen the noise and reduce the violence of the jolting.

INCOMPRESSIBILITY OF RUBBER.

Rubber, unfortunately, although elastic to a remarkable degree and extremely pliable, is nevertheless almost incompressible, much more so, indeed, than the greater number of solid bodies—a strange fact, which is but little known.

Consequently, tires made of solid rubber give practically the same result as if hollow and filled with water. With such a tire, a jolt would cause but a very small alteration in its shape, on account of the slight displacement of the molecules of water, which move slowly among themselves.

But in an air-filled tire a similar jolt would cause a great change in shape because of the instantaneous displacement of a complete layer of the compressed air, the molecules in this case being extremely rapid in their movement.



STOPPING AIR FROM A MINE FIRE.

AIR MATTRESSES FOR CONFINING MINE FIRES

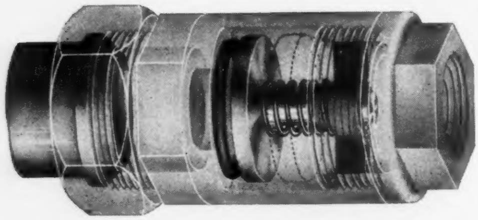
In the current issues of *Coal Age* a discussion has been in progress as to the best methods of dealing with mine fires. From letter No. 24, by Carl Scholz, Vice President and General Manager, Consolidated Indian Coal Co., is as follows:

I think that when a fire occurs at the end of an entry, the first thing to do is to diminish the circulation of the air past the fire. Under ordinary conditions, it would seem easier to build a wall on the intake side first; then, by reversing the circulation, the smoke could be forced back so that the fire would be confined to the smallest possible area. This would reduce the supply of air, walled in with the fire, to a minimum. To accomplish this, it is best to set the first stopping of brattice cloth or lumber far enough ahead of the last open cross-cut to permit of the building of a permanent wall between the crosscut and the temporary brattice.

In some gassy mines, square air mattresses, blown up by a hand air pump, as in the illustration, are utilized to make the first stopping. With these provided, in about four minutes the circulation can be stopped and the sealed-off territory reduced to a much smaller limit than could be done if the men had to build more elaborate stoppings in the smoke.

I inclose a rough sketch of such a pneumatic curtain. It can be folded up and quickly carried to the place affected. The mattress is 14 in. thick, and in its other dimensions is the size of the heading it is intended to fill. A central plate, with a pipe affixed thereto, permits the attachment of a rubber hose, through which the air can be pumped into the mattress for purposes of inflation. The bag stopping is supported temporarily by four legs, two of which are hinged to the central plate just mentioned, and two to a corresponding plate at the rear. The front and back walls of the mattresses are prevented from bulging outward under the air pressure by the use of ribbon stays. When the bag is properly inflated, it fits and adheres to all the various irregularities of the outline of the heading, and is prevented from forming itself into the shape of a balloon by the restraining force of the stays, just mentioned.

Some large turbo-compressors are now in successful operation in Germany. One of these installed at the Reden mine, near Saarbrucken, runs at 4,200 r. p. m. and compresses over 4,000 cu. ft. of free air per min. to 90 lbs. gage. Another, installed in Westphalia, runs at the same speed with a capacity of 6,000 cu. ft. of free air per min. delivered at a pressure of 105 lbs. gage. The efficiency of the compressor, compared with isothermal varies between 64 and 65 per cent. The steam turbine works with exhaust steam at efficiency of about 68 per cent. and with boiler steam at 66 per cent.



THE PEERLESS AIR CHECK VALVE

The check valve here shown in a "phantom" halftone is found very satisfactory in trolley car service, and it would seem to be deserving of wider employment. It is simple and effective and requires no explanation as to its working. It is used in a vertical position, instead of the horizontal as here shown, and is placed in the air delivery pipe between the compressor and the reservoir, preferably as near to the latter as possible. In trolley car brake service the electric driven compressor, automatically controlled, works intermittently with usually considerable intervals of rest. It is an open secret that compressors are not absolutely air tight, and when not at work, if the delivery pressure is constantly upon them, more or less air is lost while the compressor must start up against the pressure, whatever it may be. With the check valve in the pipe the loss of air is avoided, except the little remaining in the pipe itself, and the leakage here and back through the valves and piston enables the compressor to start with little or no load, a very important feature in connection with the electric drive.

NOTES

A Montreal syndicate, it is reported, has prepared plans for a million-horse-power hydro-electric development near Montreal. It is proposed to divert the whole course of the St. Lawrence River at Coteau and Cedar Rapids. The cost of the dam will be $25,000,000, and the syndicate's capitalization is said to be $100,000,000. To pay dividends on this sum will require the development of nearly one-half million horse-power.

The oldest road in America, in all probability, will shortly be macadamized by the Isthmian Canal Commission. It runs from the ruins of the old city of Panama to Cruces, on the Chagres River, where it was customary in the old days to take boats to Fort Lorenzo or to take a trail constructed somewhat later to Porto Bello. The road was in use before 1537 and was paved with cobble stones and flat rocks. There will be about 18 miles of this famous treasure route macadamized.

One individual commented on the fact that there must be plenty of coal near to New York because while coming into town the other day he saw many car loads of it standing on track. "Why," said he, "there must be a mile of coal-laden cars out there on the meadows." Well, granted that there was a mile of coal-laden cars and taking the cars as containing 50 tons each on an average, how many tons does that figure out? Just about 6,000; enough for one trip of the Lusitania.

Two doctors in Chicago have recently devised an electrically-operated mechanism for producing artificial respiration during operations of lung surgery. Air is introduced into the lungs by a compressor through a valve operated by an electro-magnet. The valve is opened and closed periodically under control of a clock mechanism. This apparatus is reported to have sustained life in a dying patient for twenty-nine hours, while the surgeons were endeavoring to restore the lungs to the performance of their natural functions.

A very large pneumatic caisson was recently sunk in the foundations of the Telephone Building in New York. It is 35 ft. 4¼ in. x 38 ft. 2 in. in plan and is built entirely of reinforced concrete. This is said to be the largest pneumatic caisson for the foundations of a building on record. Ten building columns will be carried upon it. The contractors, the O'Rourke Engineering Construction Company, of New York, completed the work of sinking it 40 ft. below the level of the curb in 3½ days.

An automatic air door is described in *Bergbau.* The door opens automatically when a car or train of cars rolls upon the inclined rails. The car pulls the lever down by its weight and the axis with bevel gear wheel, which is attached above the door, makes a

slight turn. This movement communicates itself to the door hinges and the door opens. The upright bars and the counter-weight close the door again. The weight can be regulated so that the door will open when workmen step on the inclined rails. The great advantage in this automatic door is the fact that it does not come in contact with the cars or locomotives of trains and is safe against all chance of damage through a collision.

Admitting compressed air into the gas-engine cylinder at the end of the exhaust stroke is proposed in a recent issue of the *Zeitschrift des Vereines Deutscher Ingenieure*. It is recognized that the residual burned gases remaining in the cylinder and mixed with the new charge dilutes the fresh mixture, impoverishes it, and generally interferes with the ignition of the charge, unduly elevates the initial temperature, predisposes the motor to premature explosion, and affects the efficiency of operation. It was there shown by means of diagrams and figures of a number of tests how the efficiency was increased as the result of the adoption of the valve which admits the air under pressure at the end of the exhaust stroke.

In explosives for use in the open air, such as, for example, quarrying or railroad excavation, strength and efficiency in removing rock are the qualities that are most important, and usually are the only ones that need consideration. Explosives that are to be used in tunneling must not only possess strength and efficiency, but also be of such composition that upon exploding they will not give off large quantities of poisonous or offensive gases. In explosives intended for use in coal mines, a further property is most important. Besides possessing the qualities of strength, efficiency in breaking down coal, and freedom from poisonous explosion products, the explosive should be of such nature as not readily to ignite explosive mixtures of gas or coal dust.

The Swiss seem to take naturally to tunnels. On the chief line from the North, passing southeast from Basel to Olten, the railway goes under one of the Jura ranges by the Hanentein tunnel, which has the respectable length of 8,187 ft. Not satisfied with that, the Swiss have let a contract to straighten 10 miles of the line, by which they will shorten the distance 369 ft., but at the cost of an entirely new tunnel no less than five miles long (26,698 ft.). Of course it is not for the sake of the saving in distance that this great work is undertaken. The old tunnel rises with a grade of 139 ft. per mile, and it has become almost impossible on account of the steep grade to get the traffic through this tunnel. The steepest grade on the new line is to be only 56 ft. per mile, and its summit will be 361 ft. lower than the summit of the existing line.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

FEBRUARY 6.

1,016,263. VACUUM-CLEANER. JOHN H. GREEN, Springfield, Ill.

1,016,264. SENDING AND DELIVERY STATION FOR PNEUMATIC-DESPATCH-TUBE APPARATUS. KARL ANTON GUTKNECHT, Hamburg, Germany.

1,016,384-5. RAILWAY-SIGNAL. WALTER P. ALLEN, Ardmore, Pa.

1,016,411. TRACK-CLEANER. LOUIS ISAACS, Louisville, Ky.

1,016,415. SAND-BLAST DEVICE. ALBERT JORN, Jr., Waukegan, Ill.

1. In a sand blast machine, a nozzle, a table at one side of the upper portion of the nozzle, said table having an inclined portion, means for piling sand upon the table and adjacent said inclined portion, and means for directing an air blast into the nozzle.

1,016,418. PNEUMATIC SUSPENSION FOR VEHICLES. WILLIAM KNEEN, London, England.

1,016,487. ETCHING APPARATUS. JAMES S. FREER, Rutherford, N. J.

1. An etching apparatus comprising a tank adapted to contain an etching bath, an air distributing pipe arranged at the bottom thereof and having a plurality of air egress openings, a pair of alined bearings in the tank above said pipe, a rock shaft hung in said bearings, means for clamping a work plate to said shaft, manually operable means for turning the shaft and thereby swinging the work plate into a horizontal position beneath the level of the bath, and a stop for checking the descent of said plate.

1,016,558. PNEUMATIC ATTACHMENT FOR VEHICLE-WHEELS. HERMAN GARRISON, Chicago, Ill.

1. An attachment of the character described consisting of a pneumatic tire of the ordinary construction fitted to the rim of the wheel, and an expansible pneumatic mounted on the wheel in communication with said tire and between the hub and rim of the wheel, said pneumatic comprising a pair of spaced apart plates, a flexible construction extending between the respective edges of said plates, and means to press one of said plates toward the other.

1,016,577. BLOWING-ENGINE. JOHANN F. M. PATITZ, Milwaukee, Wis.

1,016,600. VACUUM-CLEANER. EUGENE W. APPLEGATE, Hoboken, N. J.

1,016,603. COMBINED INTERNAL-COMBUSTION ENGINE AND COMPRESSED-AIR ENGINE. CHARLES WHITING BAKER, Montclair, N. J.

1. The combination of an internal-combustion engine having air-compressing cylinders arranged tandem with the engine cylinders but absorbing a part only of its power, a reservoir to which the air from the compressing cylinders is directly piped, a reciprocating compressed air engine drawing its supply from the reservoir and driving the same shaft as the internal-combustion engine, and a heater separated from the engine in which the exhaust gas from the internal-combustion engine imparts heat to the compressed air in its passage from the reservoir to the air engine.

1,016,651. PNEUMATIC SPRING. WILLIAM H. STAATS, Colonie, N. Y.

1,016,656. PROCESS OF CURING MEAT. CHARLES B. TRESCOTT, Indianapolis, Ind.

3. The process of curing meat for the purpose set forth, which consists in confining it against the access of air, pumping out the air in and about the meat supplanting said air with carbonic acid gas, and subjecting the meat so treated to the action of salt.

1,016,658. CONTROLLER FOR PNEUMATIC MOTORS. EUGENE T. TURNEY, Rock Island, Ill.

1,017,086. PROCESS OF REMOVING ALCOHOL FROM AND PURIFYING BEER. HENRY E. DECKEBACH, Cincinnati, Ohio.

The process of treating beer consisting of withdrawing it from the fermenting tub, passing heated, compressed air through it, carrying off the air, sending the beer through a cooler, thence carrying it through a strainer, returning it from the strainer to the fermenting tub, and continuing the circulation until the beer has been lowered to the desired temperature.

1,017,216. FLUID-CLUTCH. GUSTAVE T. JOHNSON, Chicago, Ill.

1,017,240. AERATION OF LIQUIDS. ARTHUR JAMES BILLOWS, Melbourne, Victoria, Australia.

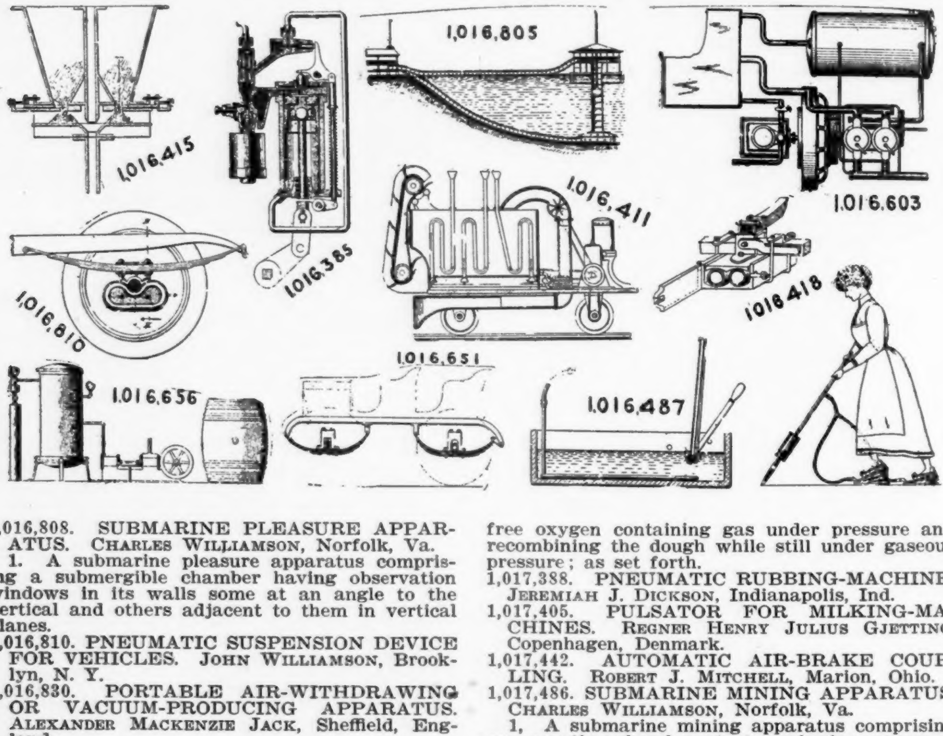
1,017,258. OZONIZING APPARATUS. MAX FUSS, Berlin, Germany.

1,017,275. SUCTION-CLEANER. JOHN GEORGE WALKER, Sewaren, N. J.

1,017,358. AIR-BRUSH. OLAUS C. WOLD, Chicago, Ill.

1,017,361. AERATION OF DOUGH. MATTHEW A. ADAM, London, England.

1. A process of dough treatment consisting in subdividing the dough exposing it to a suitable free oxygen containing gas under pressure and recombining the dough while still under gaseous pressure; as set forth.



1,016,808. SUBMARINE PLEASURE APPARATUS. CHARLES WILLIAMSON, Norfolk, Va.

1. A submarine pleasure apparatus comprising a submergible chamber having observation windows in its walls some at an angle to the vertical and others adjacent to them in vertical planes.

1,016,810. PNEUMATIC SUSPENSION DEVICE FOR VEHICLES. JOHN WILLIAMSON, Brooklyn, N. Y.

1,016,830. PORTABLE AIR-WITHDRAWING OR VACUUM-PRODUCING APPARATUS. ALEXANDER MACKENZIE JACK, Sheffield, England.

1,016,896. SYSTEM FOR INFLATING PNEUMATIC TIRES. CHARLES A. RIVERS, Denver, Colo.

1,016,917. PNEUMATIC PLAYER MECHANISM. FRANCIS W. DRAPER, Richmond, Ind.

FEBRUARY 13.

1,016,934. FLUID-METER. THOMAS CHARLTON, Chicago, Ill.

1,016,938. SIPHON-SKIMMER. CHESTER A. GILKERSON, Joliet, Ill.

1,017,001. TURBINE-BLOWER. PATRICK H. KANE, Buffalo, N. Y.

1,017,011. AIR-BRAKE. WILLIAM E. MEAD, Marshall, Tex.

1,017,388. PNEUMATIC RUBBING-MACHINE. JEREMIAH J. DICKSON, Indianapolis, Ind.

1,017,405. PULSATOR FOR MILKING-MACHINES. REGNER HENRY JULIUS GJETTING, Copenhagen, Denmark.

1,017,442. AUTOMATIC AIR-BRAKE COUPLING. ROBERT J. MITCHELL, Marion, Ohio.

1,017,486. SUBMARINE MINING APPARATUS. CHARLES WILLIAMSON, Norfolk, Va.

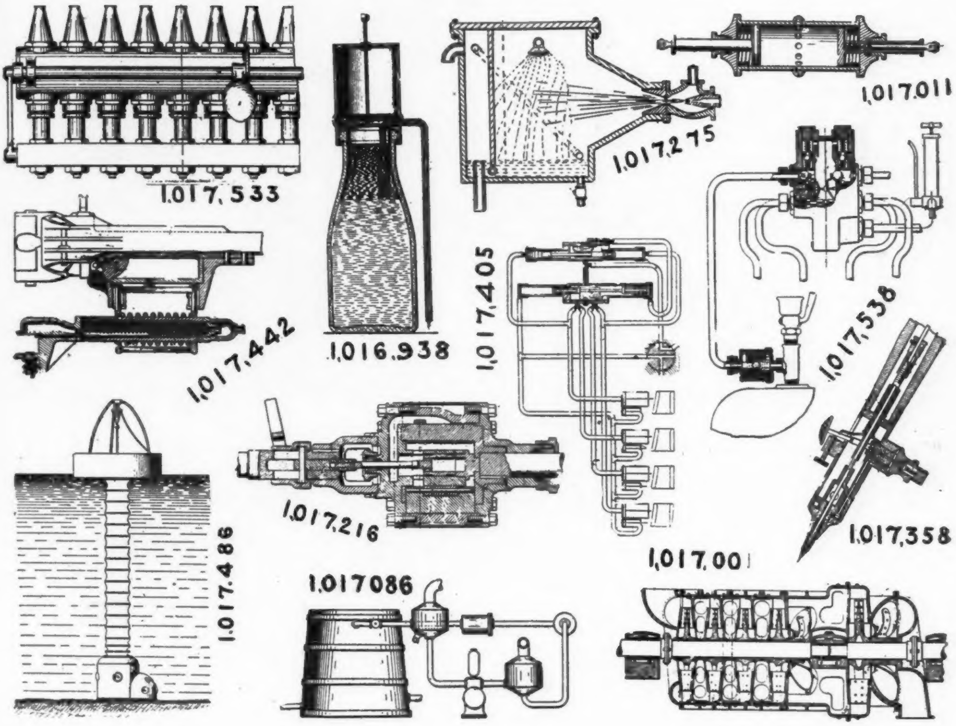
1, A submarine mining apparatus comprising an operating chamber at atmospheric pressure, a work chamber at high pressure associated therewith, means for operating in the work chamber from the operating chamber, a movable receptacle for receiving the products mined, and means for moving said receptacle into and out of said work chamber.

1,017,533. ATOMIZING-NOZZLE. JOSEPH E. J. GOODLETT, Memphis, Tenn.

1. In an atomizing nozzle, a liquid supply head provided with atomizing nozzles, an air supply head, and air conduits movable within said atomizing nozzles and provided with valve heads adapted to open and close the latter.

1,017,538. ENGINE STARTING APPARATUS. EDWARD A. HALBLEIB, Rochester, N. Y.

1. An automatic selector for engine-starting



apparatus having, in combination, valves for controlling the admission of air to the respective cylinders of an engine, said valves being movable into open position by pressure from the respective cylinders, and connections between the valves whereby movement of either valve to open position causes the movement of a plurality of the other valves to closed position.

1,017,562. PNEUMATIC HAMMER. ERNST HJALMAR LAGERSTROM, Stockholm, Sweden.

FEBRUARY 20.

1,017,648. VACUUM LIGHTNING-ARRESTER. FRANK SPENCER CHAPMAN and JOHN TYLER GREENE, Toledo, Ohio.

1. A vacuum lightning arrester, comprising a chamber, a central perforated insulating barrier located in said chamber, and a pair of conducting plates having inwardly extending projections directed toward said perforated plate.

1,017,685. JOLT-RAMMING APPARATUS. EDGAR H. MUMFORD, Philadelphia, Pa.

1,017,704. TESTING APPARATUS FOR HOLLOW CASTINGS. GEORGE C. TALLMAN, Syracuse, N. Y.

1,017,707. CASTING APPARATUS. FRANK W. TRACY, Chicago, Ill.

1. A casting apparatus comprising a closed crucible, a flask below said crucible the sprue of which is in register with the gate of said crucible, means for supplying molten metal to said closed crucible consisting of a measuring chamber and alternating operative valves controlling the feed and discharge of said chamber, and devices for supplying air under pressure to said crucible and forcing the molten metal into said flask.

1,017,722. GAS-PUMP FOR OIL-WELLS. JAMES PHILLIP WINTZ, Ripley, W. Va.

1,017,746. PNEUMATIC GUN FOR THROWING LIFE-LINES. INGEBRIGT J. GLERUM, Devils Lake, N. D.

1,017,779. PNEUMATIC CARPET-SWEEPER. THOMAS LYONS, Cleveland, Ohio.

1,017,787. AIR-BRAKE APPARATUS. BLYTHE J. MINNIER, Watertown, N. Y.

1,017,835. APPARATUS FOR COMPRESSING AND DISTRIBUTING AIR UNDER PRESSURE. MELVILLE C. WILKINSON, Paloverde Valley, Cal.

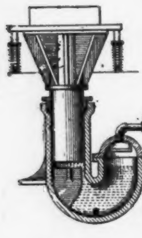
1. An air compressing and distributing mechanism, comprising a compressing means, a system of piping connected with the induction and the eduction sides of said compressor, a movable member interposed between the sides of said system and operable by the relative pressures in the two sides of the system for causing the compressor to take air from either side of the system and thus maintain the pressure in the two sides at a given rate with respect to each other.

1,018,109. RODENT-EXTERMINATOR. DELVIN B. HARRIS, Minturn, Cal.

1. A device of the character described comprising a liquid tank, an air pump, a hose having a nozzle on its end, means connecting said tank and said air pump with said nozzle, points projecting outwardly from said nozzle, batteries disposed at a distance from said nozzle, wires extending from said batteries to said points, and means for completing a circuit through said batteries and to said points for the purpose of forming a spark as described.

1,018,221. COMPRESSOR. JAMES B. VERNON and GEORGE DE CAMP, St. Louis, Mo.

1,018,238. DETACHABLE RIM FOR PNEUMATIC TIRES. PERRY ERNEST DOOLITTLE, Ontario, Canada.



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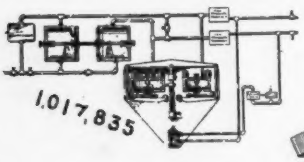

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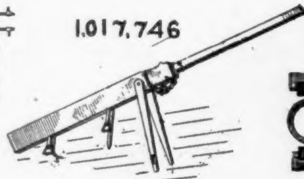

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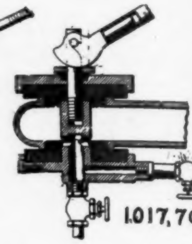

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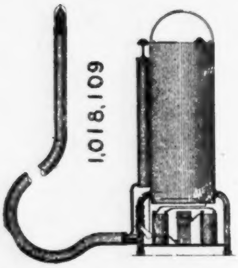

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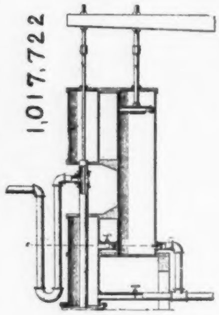

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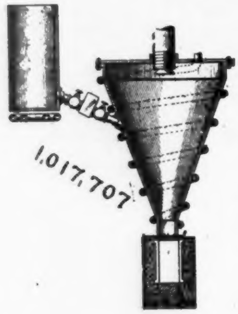

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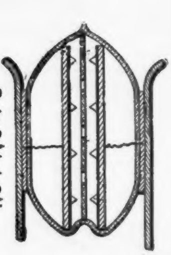

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FEBRUARY 27.

1,018,412. FLUID-ACTUATED CLUTCH. RUDOLF DIESEL, Munich, Germany.

1,018,428. PNEUMATIC WHEEL-HUB. FRED J. KOCH, East St. Louis, Ill.

1,018,483. APPARATUS FOR BLOWING PIPE-ORGANS, HARMONIUMS, OR LIKE MUSICAL INSTRUMENTS. LOUIS BERTRAM COUSANS, Lincoln, England.

1,018,561. METER. EMBURY A. HITCHCOCK, Columbus, Ohio.

1,018,568. APPARATUS FOR MAKING SOLID CARBON DIOXID. HARRY P. JULIUS, St. Louis, Mo.

A condensing and compressing apparatus for liquid carbon dioxid, comprising a tube, a head detachably mounted in one end of said tube having means for connection to the outlet of a liquid carbon dioxid storage tank, a second head detachably mounted in the other end of said tube having a threaded opening therethrough, a threaded bushing mounted in said threaded opening, a stem non-rotatably mounted in said bushing and adapted for reciprocation longitudinally of the tube, and a reciprocating plunger mounted in said tube and secured to said stem.

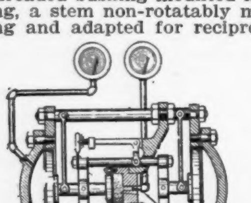
1,018,582. PRESSURE-GAGE. THOMAS A. NELSON, Chicago, Ill.

1,018,610. MILKING-MACHINE. REGNER HENRY JULIUS GJETTING, Copenhagen, Denmark.

2. A milking machine comprising in combination, a flap, a second flap movable with respect thereto, means mounting said second mentioned flap permitting oscillation and reciprocation thereof, a cylinder adapted to confine fluid pressure, a piston within said cylinder, means operatively connecting said piston and second mentioned flap to normally draw the same away from said first mentioned flap responsive to fluid expansion within said cylinder, and mechanism for imparting a forward and downward movement to said second mentioned flap, with respect to said first mentioned flap, subject to return movement thereof responsive to action of the fluid pressure within said cylinder.

1,018,772. PNEUMATIC CLUTCH-CONTROLLER. WALTER D. NICKUM and MARTIN CLAUSSEN, Los Angeles, Cal.

1,018,983. PNEUMATIC TOOL. JOHN J. PADBURY, Rockland, Me.



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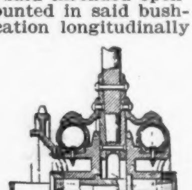

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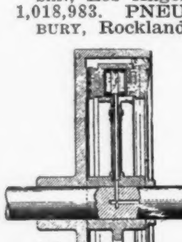

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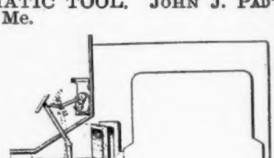

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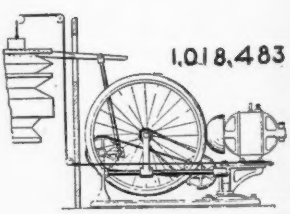

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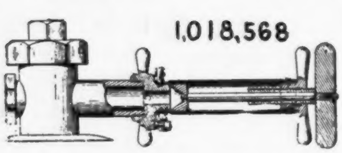

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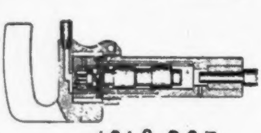

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